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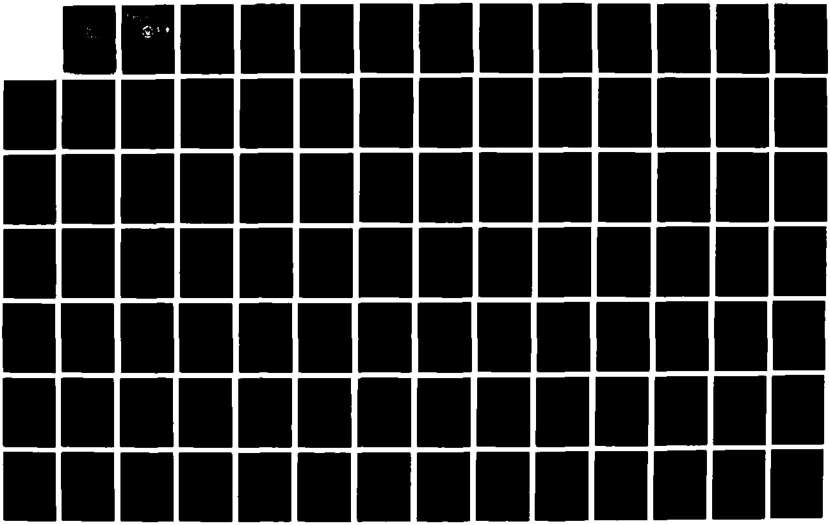

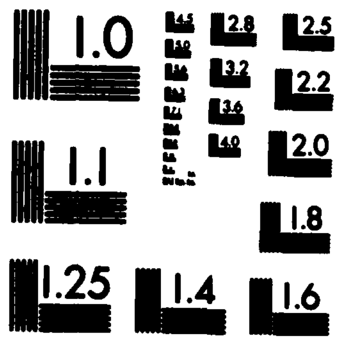
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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

IMPLEMENTATION PROPOSAL OF COMPUTER-BASED OFFICE AUTOMATION FOR REPUBLIC OF KOREA ARMY INTELLIGENCE CORPS. (ROKAIC)

by

Joo, Dae Joon

March 1987

Thesis Advisor: Norman R. Lyons

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unclassified

SECURITY CLASSIFICATION OF THIS PAGE

AD-A181 489

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION unclassified	1b. RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION / DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b OFFICE SYMBOL (If applicable) 54	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000	7b. ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification) IMPLEMENTATION PROPOSAL OF COMPUTER-BASED OFFICE AUTOMATION FOR REPUBLIC OF KOREA ARMY INTELLIGENCE CORPS.(ROKAIC)

12 PERSONAL AUTHOR(S) Joo, Dae Joon

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Master's Thesis	FROM ____ TO ____	1987 March	107

16 SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Office automation; computer-based office automation; integrated office systems; implementation; ROKAIC

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The availability of computer technology and its continually declining costs has led to its application in the office environment. The use of computer and micro electronics in the office for the support of secretarial and managerial staff has been given a number of titles, the most common term being "Office Automation" (OA). OA is a working environment that brings together a useful combination of flexible and conveniently accessible, integrated, and compatible, computer-based service functions and facilities at the user's workplace. The purpose of this thesis is to provide an implementation strategy for an integrated office automation system in the Republic of Korea Army Intelligence Corps (ROKAIC) computer system.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Prof. Norman R. Lyons	22b TELEPHONE (Include Area Code) (408) 646-2666 22c OFFICE SYMBOL Code 54Lb

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
unclassified

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Implementation proposal of Computer-based Office Automation for Republic Of Korea Army Intelligence Corps. (ROKAIC)

by

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B.A., Korea University, Seoul, 1983

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1987

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ABSTRACT

The availability of computer technology and its continually declining costs has led to its application in the office environment. The use of computer and micro electronics in the office for the support of secretarial and managerial staff has been given a number of titles, the most common term being "Office Automation" (OA). OA is a working environment that brings together a useful combination of flexible and conveniently accessible, integrated, and compatible, computer-based service functions and facilities at the user's workplace. The purpose of this thesis is to provide an implementation strategy for an integrated office automation system in the Republic of Korea army intelligence corps (ROKAIC) computer system.

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ACKNOWLEDGEMENTS

I would like to express my thanks for the support and guidance given by my thesis advisor, Professor Norman R. Lyons, and my second reader Professor Thomas P. Moore, in completing this thesis.

I would like to thank the superintendent of the Naval Postgraduate School for allowing the opportunity to study in Naval Postgraduate School.

A very special thanks to my lovely wife, Myung Sook Jung, for her help in typing of this thesis and for her assistance during our stay in the United States.

I. INTRODUCTION

A. GENERAL

The primary function of an office is to process and communicate information effectively and efficiently throughout an organization. The terms used most frequently to describe this function are: "Office Automation (OA)", "Office Information System", "Office of the Future", "Electronic Office", or "Integrated Office System".

Office automation includes the process of automating the input and creation functions, such as dictating, typing or keyboarding; the processing and replicating functions, such as reproducing copies; and the distribution function.

Arnold Keller, vice president and publisher of *Infosystems* magazine best summarizes the office automation concept in the following remarks:

> Too many people view office automation as a replacement for people. We hear and read about the electronic office and the paperless office. Regarding the latter, we are reminded of the statement of Bob Murray, vice president of the Diebold Group. Said Bob, 'You show me the paperless office and I'll show you the peopleless office. But you show me first'.
>
> An so it will be with the office of the future. Not paperless. But rather an office adapting today's technology to the needs of the worker. Paperwork will be simplified, not eliminated. People will be more humanized. The office will become an effective management information center, and people will play the major role. [Ref. 1: p. 26]

B. PURPOSE OF THE THESIS

Although the Republic of Korea army intelligence corps (ROKAIC) has computer systems, it still does not take full advantage of existing computer facilities. The current systems require modern OA technologies and tools to obtain optimal performance from them. Consequently, the purpose of this thesis is to provide an implementation strategy for an integrated office automation system in the ROKAIC system.

C. SCOPE OF THE THESIS

The first chapter contains an the overview of this thesis and presents general concepts for each chapter. Chapter II provides an introduction to office automation. It discusses the motivations behind office automation and the primary models and

methodologies used in today's office. Chapter III is devoted to the actual form of the technology being used today and its integration into office systems. Chapter IV describes the mission, organization, and computer center of ROKAIC and how the ROKAIC personnel functions in their offices. In this chapter, the problems with the existing system are defined and the structured system analysis and design methodology is used to determine a feasible solution.

In Chapter V, an appropriate model for improving office services based on a computer system is defined. First, a logical model and data dictionary for the proposed office automation system is developed. Next, the system flowcharts for the proposed system based on the logical model are generated. Finally, general strategy and principles for the implementation stage are discussed.

This thesis will conclude with an implementation strategy for integrating an office automation system into ROKAIC system.

II. INTRODUCTION TO OFFICE AUTOMATION

A. DEFINITION

Office Automation (henceforth referred to as OA) is as revolutionary to the office today, as the typewriter was to the office at the turn of the century. It is changing the way we do business, the nature of the business, the type of jobs that are performed, as well as how they are performed. Also, OA is significantly affecting the social aspects of the office at the principal, secretarial, and clerical levels.

Today's office has evolved to the highly sophisticated form as the result of such factors as population growth, production specialization, and technological inventions and innovations. All organizations, no matter what size, have two common needs, to communicate internally and externally, and to process information.

There is no universally accepted term to describe the application of new office technology and systems in the office. Definitions offered in the literature range from the very broad and general to the specific. Ellis and Nutt (1980) in an attempt at a more specific definition of office automation state: "an automated office information system attempts to perform the functions of the ordinary office by means of a computer system." [Ref. 2: p. 6]

This definition tries to attach a significance to the new technology, although it seems to be limited to a computer system. This, most would argue, is too limiting as it would tend to exclude products such as local area networks.

Office Automation (henceforth referred to as OA) is as revolutionary to the office today, as the typewriter was to the office at the turn of the century. It is changing the way we do business, the nature of the business, the type of jobs that are performed, as well as how they are performed. Also, OA is significantly affecting the social aspects of the office at the principal, secretarial, and clerical levels.

In sum, no single definition appears to capture the entirety of office automation. However, a reasonable alternative is offered by the amalgamated definition of Olson, Lucas, and Zisman. It is presented below and will be used throughout this thesis:

> Office automation, in its current form, refers to the application of integrated computer, communication, and office product technologies and social science knowledge to support the myriad activities and functions in an office or office environment. [Ref. 2: p. 16]

B. DEVELOPMENT OF THE OA

1. General

According to Bracchi and Pernici, the development phases for office systems are similar to those found in conventional systems. In the requirements analysis phase, the office 'reality' is studied and requirements investigated. These requirements are then formally specified using a conceptual model of the office. This is the office requirements specification phase. An ongoing process of evaluation is used to monitor the development, and generates modifications as they are required. Figure 2.1 depicts the OA development process.

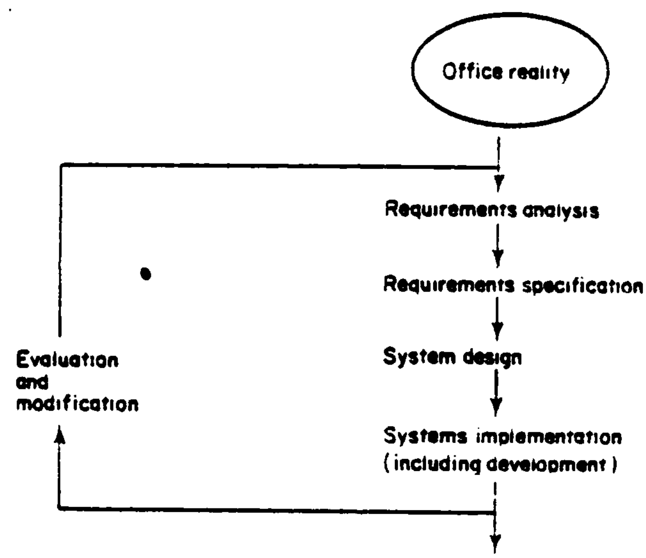

Figure 2.1 Phases in OA systems development.

2. Methodologies

Most effort to date has been focused on the problem of formally specifying office elements in a model, rather than the development of a complete methodology. Therefore, most existing so-called office automation methodologies are really only

partial methodologies, emphasizing only a subset of the OA systems development process. [Ref. 2: p. 81]

A methodology usually tries to depict: 1) the activities to be performed, 2) the relationships and sequence of these activities, and 3) the various evaluation and decision milestones which must be reached for systems development. Fundamentally the aim of an OA methodology is to make the development process easier and more reliable [Ref. 2: p. 80]. The following is a brief review of various current methodologies for office automation.

a. Mumford's ETHICS

ETHICS, an acronym for effective technical and human implementation of computer systems, is a methodology developed largely by Enid Mumford and has been evolving over the past fifteen years. It is quite different from the traditional approaches to information system development in that it is based on the ideals of sociotechnical systems (STS). Mumford defines STS as, ". . . an approach to work design which recognizes the interaction of technology and the people, and produces work systems which are both technically efficient and have social characteristics which lead to high job satisfaction." Technology, when viewed from this perspective, is much more flexible than is the case with traditional approaches. [Ref. 2: p. 111]

ETHICS is an evolving methodology. There have appeared a number of different versions over the years: some more comprehensive, others more conceptual in nature. The ETHICS methodology contains six stages divided into twenty-five steps. More detailed steps of the ETHICS methodology are mentioned in Appendix A.

b. Pava's Sociotechnical Design Methodology

Pava (1983) has developed an approach to office system analysis and design which is also based on sociotechnical system theory. Although in many ways it is similar to Mumford and Weir's (1979) ETHICS, it specifically extends the sociotechnical notion into the office domain. The office, from a sociotechnical perspective, needs to be conceptualized as an open system. Pava notes that although it is relatively straightforward to view factory work as an open system, office work is another matter. Factory work is characterized by routine transactions involving inputs of people, raw materials, and production information as well as transformation processes which yield finished products. Office work, on the other hand, is far less routine and defies comparison with factory work. Moreover, the roots of the difference are multifaceted and complex, involving social class distinctions, educational and

attitudinal differences, and historical variations. Yet, for the sociotechnical systems to be successful, it must be able to handle the non-routine aspects of office work. Pava states:

> Predominantly routine office work is well suited for established socio-technical design. Primarily non-routine office work requires a new analytic method grounded in sociotechnical theory but able to accommodate non-sequential free-flowing work. In between these extremes are jobs with relatively equal proportions of routine and non-routine tasks. A method that incorporates elements of both the conventional and the emergent procedures of sociotechnical analysis is likely to be most valuable here. [Ref. 2: pp. 125-128]

Pava lists three reasons why traditional sociotechnical analysis is not amenable to non-routine office work:

- *multiple, concurrent transformation processes*, because non-routine office work requires the person to typically manage a number of transformation processes simultaneously;
- *non-linear transformation flow*, which means that non-routine work embodies transformations completely beyond rational, fixed, or final solutions;
- (operational separatism), which notes the educational, authority, expertise, and career aspiration differences between routine and non-routine office workers.

These differences lead to a highly individualistic orientation which is not consistent with the work group notion so fundamental to traditional sociotechnical design. To overcome these differences, Pava outlines a six-step method for analyzing non-routine office work. More detailed steps of Pava's methodology are described in Appendix B. [Ref. 2: p. 126]

c. Checkland's Soft System Methodology

Checkland (1981) developed a general methodology which could be used for information systems analysis and, by extension for office automation. Checkland states that it was designed for use in broad problem-solving situations, but its relevance to systems analysis is clear. His approach has its roots in the 'systems movement', which is an alternative to the more orthodox 'reductionism' approach, and contends it is more fruitful to study 'wholes' rather than 'parts' since a reductionism approach fails to appreciate the existence of synergy, where the whole is different from the sum of its parts.

Checkland contends that traditional information systems development is based on reductionism principles, or what he calls 'hard systems thinking'. It tends to take an overly simplistic view of the world: one where there is no apparent disagreement over organizational objectives and problems. As an alternative, he offers

'soft systems thinking', a general approach to problem solving which denies the existence of a recognized and agreed on set of organizational objectives, needs, and performance measures. Checkland suggests that the universe of problems can be divided into those where hard systems thinking is appropriate and those where soft systems thinking is necessary. Information systems (and office systems) belong in this latter category. [Ref. 2: p. 105]

Checkland sees information systems within the realm of social systems which he states are composed of rational assemblies of linked activities and sets of relationships. Checkland refers to these as 'human activity systems'. He recognizes that in order to regulate the behaviour of organizational role holders and create shared expectations among individuals in an office, the formal systems are designed. Further, the heterogeneity of human behaviour and values influence the character of the total organizational system and its supporting information systems. However, Checkland notes a problem. He states:

> A purely behavioural approach based upon the idea of man as a gregarious animal will neglect the power and influence of rational design, (while) an approach which assumes human beings to be rational automata and ignore the cultural dimension will also pass the problem by. [Ref. 2: p. 105]

Thus, there is need for an approach which is formal yet captures the behavioural richness of organizational life. Checkland contends his soft systems methodology is such an approach. [Ref. 2: pp. 105-107]

Overview of this Methodology is meant for addressing fuzzy, ill-defined problems--precisely those of social systems. Hard systems thinking, which is goal directed in the sense that goals (objectives) are stated at the outset, is inappropriate as such articulated goals do not exist in social systems. Soft systems thinking starts from the point of view that human activity systems possess goals which are not quantifiable. In human activity systems, problems are manifestations of mismatches between the perceived reality and that which might become actuality.

Checkland's methodology is different from the traditional approaches in that it does not prescribe specific tools and techniques, only general problem formulating approaches. It is a framework which does not force or lead the systems analyst to a particular solution, but rather to an understanding. The steps within the methodology are categorized as 'real world' activities and 'systems thinking' activities.

The steps in the former are executed by the people in the real world or problem situation; the steps in the latter attempt to provide a conceptual model of the real world which is in turn modified by discussion with the concerned people. It is therefore a highly participatory approach. [Ref. 2: p. 107]

The methodology is shown in Figure 2.2 (It should be noted that although the stages are described in sequence, Checkland claims a project can be started at any stage; further, backtracking and iteration are not only possible but essential.).

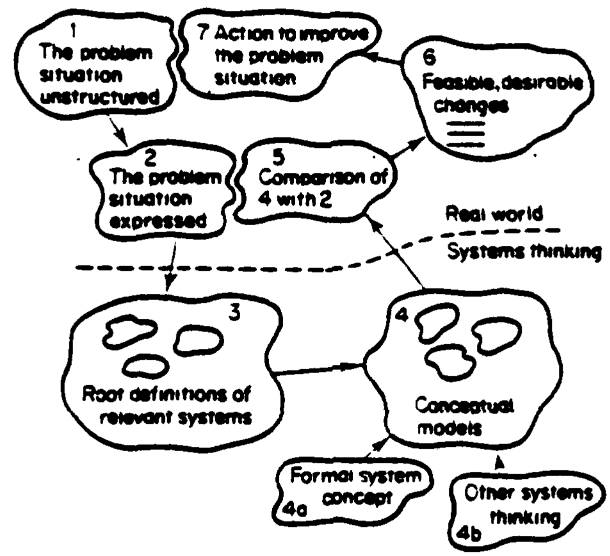

Figure 2.2 Overview of Checklend's methodology(Checklend, 1981).

d. Tapscott's User-Driven Design Methodology

Tapscott's (1982) user-driver design (TUDD) methodology is a practical approach to office automation. It is based on a three-phased, evolutionary design process involving the use of pilot studies to provide the necessary knowledge for successful office automation. *The three phases are the pre-pilot, the pilot phase and the operational system phase*. Figure 2.3 depicts TUDD.

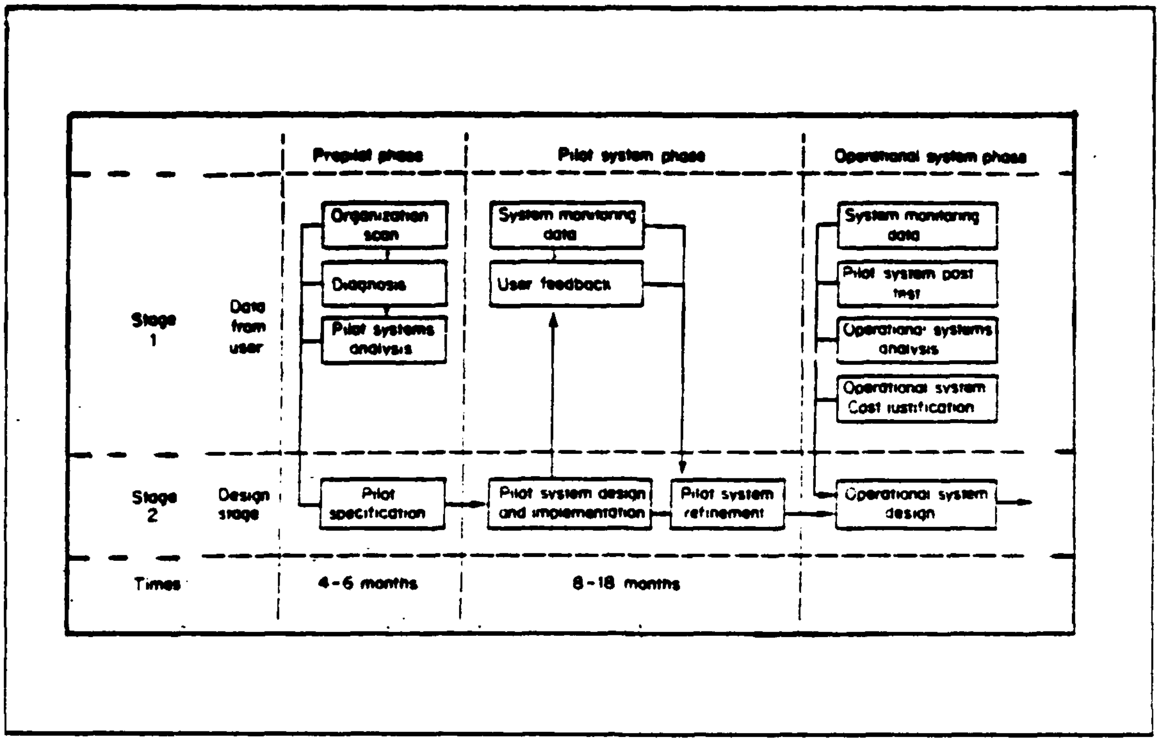

Figure 2.3 User-driven design of Tapscott.

There are two stages in the methodology: stage 1, data collection and analysis, and stage 2, design. Each phase of TUDD contains both stages, where the results of the first stage are usually fed to the second (although, on occasion, results from stage 2 of a particular phase are passed directly to stage 2 of the subsequent phase). More detailed steps of the TUDD methodology are represented in Appendix C. [Ref. 2: p. 99]

As was mentioned in the above section, four methodologies which are less formal and more participative in nature are likely to be most appropriate for office automation. Three particular approaches score well and could form the basis of office systems development: Checkland's (1981) soft systems methodology, Pava's (1983) sociotechnical design, and Mumford and Wier's (1979) STS-based ETHICS. Each has its own strengths and weaknesses but all are felt to be appropriate for office automation. It is likely that some combination of the approaches may even be better than a single one on its own.

e. Additional Office Automation Methodologies

There have been other 'methodologies' developed specifically with office automation in mind, but they have not been extensively written up in the literature or are not as fully developed as the ones previously covered. Three prime examples of such methodologies are: MOBILE-Burotique, developed as part of project KAYAK at the French research information manufacturing developed at Xerox; OADM (office analysis and diagnosis methodology) and ISAC developed in Sweden, which is based on the traditional process of taking an object system and reducing it into manageable and meaningful chunks. They are not considered very appropriate for office system development.

3. Models

a. Definition

Newman (1980) contends that office models are hypotheses about the way offices function. He sees office models being based mostly on the information-processing function of offices: information flow, information storage and retrieval, and the use of information in decision making. For Newman, "the aim of office modelling should be to construct a single model, or a consistent set of models, that provides an accurate and complete description of office activity." [Ref. 2: p. 100]

Because of the importance of having some specified meaning of the term model, it will be thought of as a conceptual structure which provides the apparatus for describing some particular situation. More specifically, it is the product of applying some representational form using a particular frame. It is an interpretive description which, hopefully, will provide valuable insight into the situation the model is attempting to reflect.

Most office models currently in existence share a fundamental notion, namely that offices can be conceived of as transaction-oriented systems. Although many transactions are performed concurrently, the activities associated with each type of transaction can be processed sequentially. Specific knowledge about how an individual type of transaction is processed can be used to infer a richer understanding of the parallel operation of an office.

b. Types of Office Models

To help produce a better understanding of office models, various authors have developed taxonomies through which the classification and comparison of office models are made possible. Newman (1980), for example, notes five types of office models:

1) Information flow models, which seek to represent office work in terms of units of information that flow between offices;

2) Procedural models, which attempt to represent office work in terms of procedures that are executed by office workers;

3) Decision -making models, which seek to describe the office in terms of the decision-making activities of managers and other office personnel;

4) Database models, which posit that office work can be described in terms of information records that are created, modified, and manipulated by means of transactions; and

5) Behavioural models, which describe office work in terms of social activities involving groups and individual action, woven into the information-processing tasks of the office. [Ref. 2: p. 90]

Tapscott (1982) distinguishes between five types of office models, which are somewhat similar to, yet distinct from, Newman's:

1) 'Organizational communication models' are models which view the office as a communication system.

2) Functional models focus on the underlying functions the office exists to fulfil.

3) Information resource management models seek to accentuate the need for effective management of the organization's information resource.

4) Decision support systems models seek to place office systems within the context of supporting the judgements of office managers and others who make decisions.

5) Quality of working life models focus on the meaning and nature of office work. [Ref. 2: p. 90]

These types also are concerned with the structure of work organizations, the process of organizational change, and the result of the change process. Notions such as sociotechnical systems, job satisfaction, job design, industrial democracy, and organizational design tend to be part of the quality of working life models. [Ref. 2: p. 91]

c. Review of Current Office Models.

The following is a brief review of some of the current office models and modelling approaches which have been developed.

(1) *Information Control Nets Based Model.* Ellis' information control nets (ICN)-based model is a mathematical flow model which is used for the analysis and description of information flow within an office. By means of a network representation, a detailed description of office activities can be achieved. Specific data about the office is gathered using an iterative approach, involving interviews, observation, and analysis. Ellis suggests that his ICN-based model is able to detect flaws or inconsistencies in the underlying office description and even perform office restructuring.

All ICNs have three basic requirements; they must be: (a) mathematically tractable, (b) simple (for easy manipulation and understanding by office workers), and (c) extensible (to enable it to include theoretical analysis and simulation). Ellis contends that it is the mathematical orientation and rigor of the ICN which sets it apart from other office models. [Ref. 2: p. 93]

The ICN-based model defines an office as a set of interrelated 'procedures' which can be further divided into a set of 'activities' that access and update information stored in what are called 'repositories'. The execution sequence for the activities are determined through 'precedence constraints'. These are simple rules stipulating the immediate successor activity for each parent activity. Upon completion of an activity, one of its successor activities is allowed to proceed. The execution of a successor activity need not be immediate after the completion of its parent activity. It is possible that the subsequent activity may be busy, e.g. the telephone may be in use, in which case it has to go into a wait state until the resource becomes free.

In the ICN model, the four primitives (i.e. procedures, activities, repositiories, and precedence constraints) are usually represented graphically or as a set of mappings defined over groups of activities and repositories. ICN diagrams normally use the following conventions: rectangles represent permanent repositories; triangles, temporary repositories; labelled circles, activities; small unfilled circles, conditional branches; small solid circles, start (or end) of parallel activity sequence; light arrows, repository accesses and updates; and dark arrows, precedence constraints. Figure 2.4 depicts order processing and information control net diagrams.

(2) *Augmented Petri Nets Based Model.* The system for computerization of office processing (SCOOP), developed by Zisman (1977, 1978), uses augmented petri nets. It is so named because the system is based on petri nets augmented by production rules. SCOOP places particular emphasis on the specification, representation, and automation of office procedures. The main focus is on the automating of office procedures without necessarily considering the automating technology. It views the office as a system of asynchronous concurrent processess, which allows the office to be regarded as an environment where many primarily independent, event-driven tasks occur concurrently.

Fundamental to SCOOP is the production system--the formalism for knowledge representation. It is made up of three parts: a set of rules or 'productions' constituting a condition or action; a database or 'context' allowing state data to be

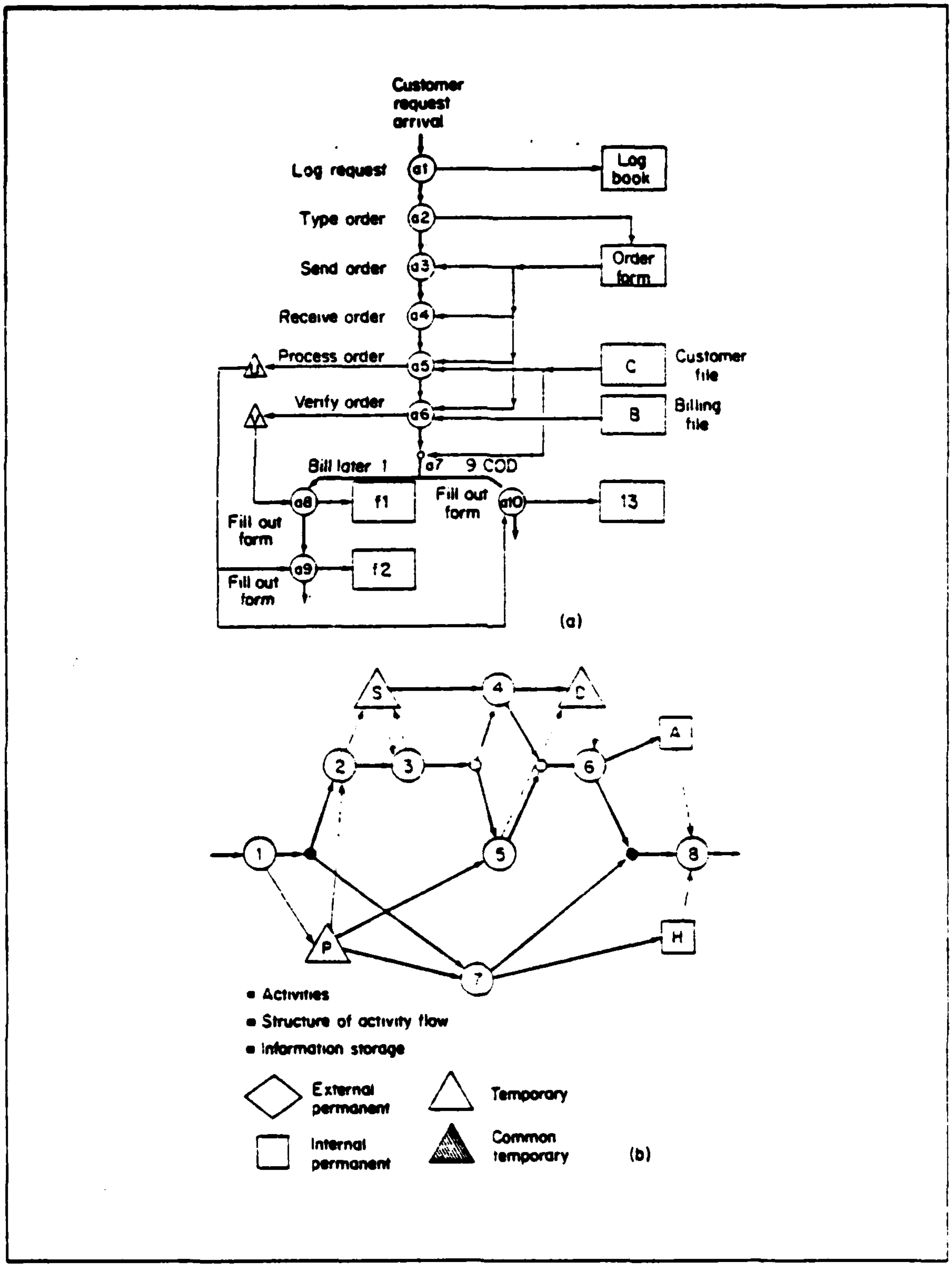

Figure 2.4 Examples of ICN diagrams.

maintained; and a rule interpreter. The PS functions by testing the condition within each rule, if the condition is deemed to be true the consequent action is performed. Many conditions may be required to trigger a single action and a single action might result in several conditions. [Ref. 2: p. 96]

The second fundamental element of SCOOP is the petri net, a formalism for process representation whose graphical representation has been defined by Miller (1973) as follows:

> A petri net is a graphical representation with directed edges between two different types of nodes. A node represented as a circle is called a 'place', and a node represented as a bar is called a 'transition'. The places in a petri net have the capability of holding tokens. For a given transition, those places that have edges directed into the transition are called 'input places', and those places having edges directed out of this transition are called 'output places' for the transition. If all the input places for a transition contain a token, then the transition is said to be active. An active transition may fire. The firing removes a token from each input place and puts a token on each output place. Thus, a token in a place can be used in the firing of only one transition. [Ref. 2: p. 96]

Because it has two types of nodes, 'places' and 'transitions', with an arc passing between the nodes, the petri net may be termed a bipartite directed graph (Peterson, 1977). Figure 2.5 depicts the representation of a petri net showing conflict.

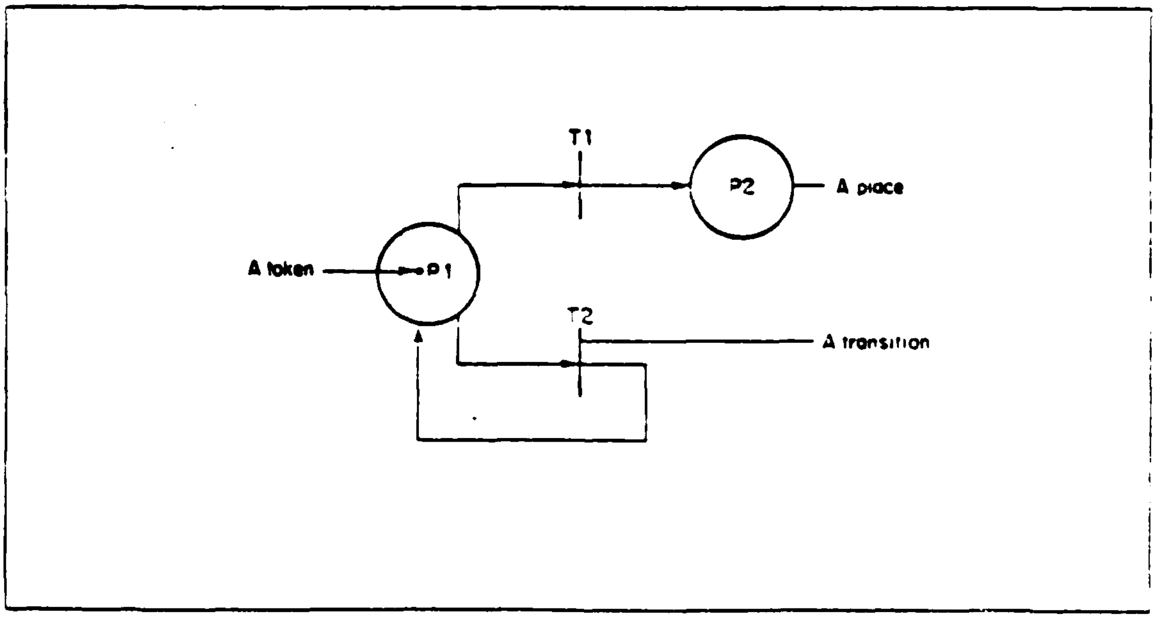

Figure 2.5 A graphical representation of a petri net showing conflict.

(3) *Form Flow Model (FFM)*. The FFM views the office as a network of stations through which forms flow (Ladd and Tsichritzis, 1980). Information is collected on 'forms' as structured data, and processed at one of several several stations. A 'station' is the term for an abstract entity which relates a person, or their role with a physical location and device through which to operate. A form is initiated at a station within the network, processed as it moves through various stations, and ultimately terminated at a station within the network. The coordination of the route which forms take between stations is accomplished by the network. Currently, networks cannot coordinate among forms; thus forms moving between stations are assumed to be completely independent of each other.

In defining the notion of 'form', Tsichritizis (1982) distinguishes between four aspects of forms: form types, form instances, forms, and form templates. 'A form type' refers to a data type defined for a particular form. 'A form instance' represents an occurrence of a form type. 'Form' refers to the values of the attributes of a form instance. instance. 'Form template' is a mapping from a form instance to an actual business message (or business form). Forms contain three parts: type, key, and contents. Form type denotes the kind of fields a form contains, form key alludes to its unique identifier, and form contents refers to the values residing in the fields. [Ref. 2: p. 99]

(4) *OMEGA*. OMEGA is an outgrowth from the field of artificial intelligence (Barber, 1982, 1983). Technically it is a knowledge-embedding language used to embed specific office job descriptions into an office worker's workstation in support of problem solving. OMEGA's viewpoint mechanism (a general contradiction-handling facility which stores statements of rules) is used to reason about change and contradiction. When a contradiction does arise the viewpoint mechanism is utilized to reason why it occurred.

The use of OMEGA provides a record of the activities involved in the performance of specific office tasks. This description includes mental as well as physical activities relevant to a task and the reasons for the activities. Because OMEGA characterizes work by an explicit representation of goals and actions, it can expose hidden assumptions and implicit goals about office work. This form of representation proves a useful aid in handling unexpected contingencies, as well as making the actions performed by an office worker more comprehensible. Office workers are better equipped to handle unexpected contingencies because they know the

specific goals of the office work and the actions necessary to achieve these goals. They may elect to use the OMEGA to suggest an alternative plan of action or to examine the goals the alternative action must take on if the action is unable to be performed. The user's actions can also suggest what the current goals are and thus narrow the choices for solving the problem as well as reducing the solutions space.

OMEGA uses a problem-solving support paradigm. The problem-solving support paradigm is an extension of the classical view of problem solving in artificial intelligence. The paradigm is applied by the user (office worker) as follows. OMEGA either attempts to establish or refute a particular goal, based on its knowledge of the goal. If a goal cannot be established, OMEGA notifies the office worker that contradictory information is present. The office worker can then either modify the goal or insert more relevant information in order to establish the goal once again. The cycle is repeated until the goal becomes established. The analysis above is achieved by OMEGA's viewpoint mechanism--the heart of the problem solving support paradigm.

(5) *Tapscott's Model.* According to Tapscott (1982), an office model needs to conceptualize what takes in the office and organization. It needs to be hierarchical to reflect the overall goal structure of the organization. His model depicts an office as a system which receives inputs, processes them, and turns them into outputs. The model embodies a hierarchy of levels:

- *Mission (or goals).* These are articulated global objectives which the organization attempts to achieve.
- *Key result area.* These are critical areas which have to be successful for the organization to achieve its global objectives. Examples of such areas may be organization growth, worker satisfaction, organizational stability, and high productivity.
- *Functions.* These are particular independent operations (functions) which have predetermined and specific inputs and outputs. Examples of such functions are accounting, marketing, personnel, and administrative services.
- *Processes, Procedures, and jobs.* These are the three particular kinds of operations which are undertaken in the execution of the functions. 'Processes' refer to the relationships between the series of work activities performed in executing a function. 'Procedures' are the actual groups of work activities performed to achieve a specific purpose. 'Jobs' reflect the way the work activities are actually aggregated into divisible units, i.e. assigned to people with particular titles--Jobs.
- *Work activities.* These are the physical and mental tasks actually undertaken to carry out a given function. [Ref. 2: p. 92]

4. Summary

It can be seen that there exists a number of alternative office automation models and methodologies. Yet the OA literature has been remiss in not adequately defining what it means by 'model' and 'methodology' nor specifying the linkage between the two. The OA community has not bothered to articulate the relationship between model and methodology, it is felt that if one exists, it should be made explicit.

Although current methodologies need further work, STS--based approaches seem to have most to offer and additional work could help them reach their potential. Combined approaches also have much promise. Approaches such as the multiview methodology which embrace features of a number of methodologies could be developed specifically for office automation. Considerably more work is needed in providing a relatively comprehensive approach which would allow the designers the ability to choose the particular tools necessary in any given circumstance.

C. IMPLEMENTATION

In general, implementation has been thought to simply be the last phase in the systems development process. Owens (1981) suggests the need to plan for implementation. He writes:

> Successful implementation depends on a match between user needs and system design. This match is achieved through assessment of organizational and individual variables affecting implementation outcomes. Such an assessment requires extensive planning. [Ref. 2: p. 157]

Implementation can thus be defined as the execution and successful effectuation of a planned or designed change.

The implementation processes for office automation follow the same systems development processes associated with creating any new information system. Consequently, little pioneering is required which is outside the normal management procedures, and a variety of sources provide step-by-step explanatory details for systems development. What is required is creativity to implement a system that is subject to a wide range of influences: business markets will change, new products will appear and others vanish, executive changes will signal new organizational directions. Changing needs will require changes in office automation systems and a flexible system will have to be continually updated. [Ref. 3: p. 225]

While it is recognized by most leaders in the field of OA that well thought-out, strategically planned, top-down implementation procedures are the only economical and efficient method for implementing an OA system, there are others who strongly advocate the bottom-up approach, supported by pilot programs to 'sell' upper level management on the benefits to be gained [Ref. 4: p. 13]. This thesis advocates the first alternative based on the belief that business economics dictate structured design and budgetary planning. Otherwise there is little hope of gaining upper level management acceptance. High capitalization of equipment as well as high costs of money also support this approach, combined with the belief that if management does not fully support the project from the beginning then there is little chance of a successful implementation.

The system development process cited in the above references supports four major phases, each containing several steps. Each step is a logical part in accomplishing the objectives of that particular phase.

1. **Phase I : Systems Planning**

Implementation of an OA system begins with a planning phase to formalize and determine the need for the system. Within this phase the first step is to conduct an initial investigation to determine whether a feasibility study is warranted. If management (or a steering committee appointed by management) perceives that a feasibility study is worthwhile, a committee is generally appointed to proceed. The second step, the feasibility study, is a report to management of the probable characteristics, costs, and benefits of implementing the system as well as a formal report of the generalized project requirements. Reports are based on information gathered from users, systems analysts, and consultants. The end result of a feasibility study is a decision by the steering committee to either cancel the project or to proceed on with the next phase.

2. **Phase II - Systems Requirements**

The second phase of the OA system development process provides the detailed foundations upon which the technical programs and procedures will be developed. Emphasis is directed toward analysis of user operations, e.g., clerical worker, professional, or upper-level management considerations. Once user requirements are understood, then the technical aspects of the system can be determined. These include communications channels, equipment integration, and installation sites. This phase ends with another review by the steering committee and a decision to either terminate or proceed with development.

3. **Phase III - Systems Development**

This is generally the largest and most complex aspect of the implementation process. It commences with an accepted conceptual design approach and an agreement to purchase hardware, software, and applications packages for at least a pilot program. It terminates with a developed system that has been thoroughly tested and prepared for implementation. Included in this phase are the following:

- Steps to support detailed design specifications
- Implementation of the technical support functions
- Application specifications and programs
- Preparation procedures
- Training users
- Planning for conversion and full implementation
- Testing of the system

Pilot projects or proto-types are installed and user groups are afforded the opportunity to use, familiarize, and evaluate the system for usefulness and productivity.

The third phase ends with another presentation to the steering committee summarizing the results of the development and testing efforts and an agreement by all parties (users and various departments, plants, factories, offices, ets.) that the new system should be implemented. The steering committee makes a final decision to terminate the project at this time or to direct full scale implementation of the system.

4. **Phase IV - Systems Implementation**

The final phase is the actual implementation of the system as designed. During this phase files are converted or microfilmed, final training is conducted, new programs and procedures are initiated and old processes are discontinued. Refinements and tuning operations are performed to correct deficiencies and to enhance effectiveness. Finally, after sufficient operational time an corrections and a post-implementation study is completed to compare actual results to original concepts and plans.

The implementation procedures discussed above are only a guideline and in no way imply that such a methodology is fixed in concrete. On the contrary, there are probably as many ways to implement an automated office system as there are ways to configure such a system. For example, Dr. Lynn Hazlett, vice president of MIS for Levi Strauss, suggests the establishment of an information resources department responsible for development and operation of the organization's OA system. This

would entail an information processing manager, a communications manager, an management information system (MIS) manager, and an advanced planning manager all reporting to a vicepresident of the department [Ref. 5: p. 72]. No system or implementation strategy is wrong if it can be managed and made to work in an efficient and economical manner. Furthermore, no system is ever complete since changing needs will require constant update and revision throughout the life of the system.

D. BENEFITS

The potential benefits resulting from office automation have been predicted to be many and varied. They range from increases in productivity, to reduced costs, to improvements in the quality of working life of office personnel.

Office automation provides more than just expanded geographical capabilities and freedom; it provides a host of opportunities and benefits to business, tangible and intangible. The potential savings are enormous as indicated in two landmark studies conducted on OA users. The first of these, which will be mentioned many times throughout this work, was done by the consulting firm of Booz, Allen and Hamilton over a year long study of 15 large U.S. corporations. It gave conclusive evidence that within just five years of implementation knowledge workers (executive management) could save an average of 15% of their time through more highly automated support. [Ref. 6: pp. 148-150]

Roughly half the savings would come from reducing time spent in less productive activities. The balance would be derived from selective reductions in certain meetings, analytical tasks and document handling. Additionally, companies would receive a complete return on their investment within 15 months. [Ref. 7: p. 9]

The second study by Cresop, McCormick and Paget, Inc., of Chicago, Illinois, done on a large group of companies with at least $50 million in annual sales, found that users averaged 30 percent savings on administration costs (primarily through word processing), a 26 percent increase in productivity of administrative personnel, and a 20 percent increase in productivity of managers and professionals. [Ref. 8: p.12]

Furthermore, David Barcomb, author of Office Automation: *A Survey of Tools and Technology*, cites the following benefits that businesses and knowledge workers can derive from the proper implementation of OA technology:

1) Optimize staffing

- Enhance human capabilities
- Conserve human resources
- Compensate for manpower shortages
- Minimize drudgery

2) **Increase productivity**

- Improve accuracy
- Speed up throughput
- Speed up turnaround

3) Gain competitive edge

- Improve timeliness of information
- Improve decision making
- Conserve natural resources

4) Increase scope of control

- Enhance individual and organizational flexibility
- Make information portable

5) Decrease expenses

- Reduce capital investments in structures
- Reduce or cap off payroll costs. [Ref. 8: p. 12]

Chapter V makes a case for adopting office automation by taking a closer look at the benefits and opportunities to be gained.

III. TOOLS OF TECHNOLOGY

A. GENERAL

Professional office automation tools fall into one of three categories: multifunction terminals (attached to large systems and on general office automation systems), especially designed managerial workstations, and personal business computers. All have a number of similarities (such as common software based) but there are also some distinctive qualities. The differences lie primarily in their storage capacities and communications capabilities for accessing mainframe data bases.

In general, OA involves the use of five basic technologies concerned with:

1) *Data* information in the form of numbers.
2) *Word* information in the form of written words.
3) *Image* information in the form of picture.
4) *Audio* information in the form of spoken words.
5) *Communication* sharing information through networks.

The specific products involved in OA are briefly outlined in the next section. This is not an all-inclusive listing but is representative of the currently available technologies. In most cases the tools involved cut across the basic technologies.

B. DATA PROCESSING

The processing of data in organizations has become the norm. It has developed from the large centralized computer service to distributed systems where terminals with direct access to computer files are available to many clerical staff. In conjunction with this, there is the development of specialized data bases which users can access to obtain information relevant to the particular aspects or job functions they perform.

In general terms, *processing* is the component in the cycle of information flow for the manipulation of those ideas that have been input to the system to be replicated and distributed in the form of communication. Until recently, data processing was concerned with processing transactions. The primary use of computers had been in processing data transactions--a sale, a paycheck, a change in inventory, and so on. All accounting activity is concerned with data processing transactions [Ref. 9: p. 58]. Figure 3.1 shows the processing component of the information flow.

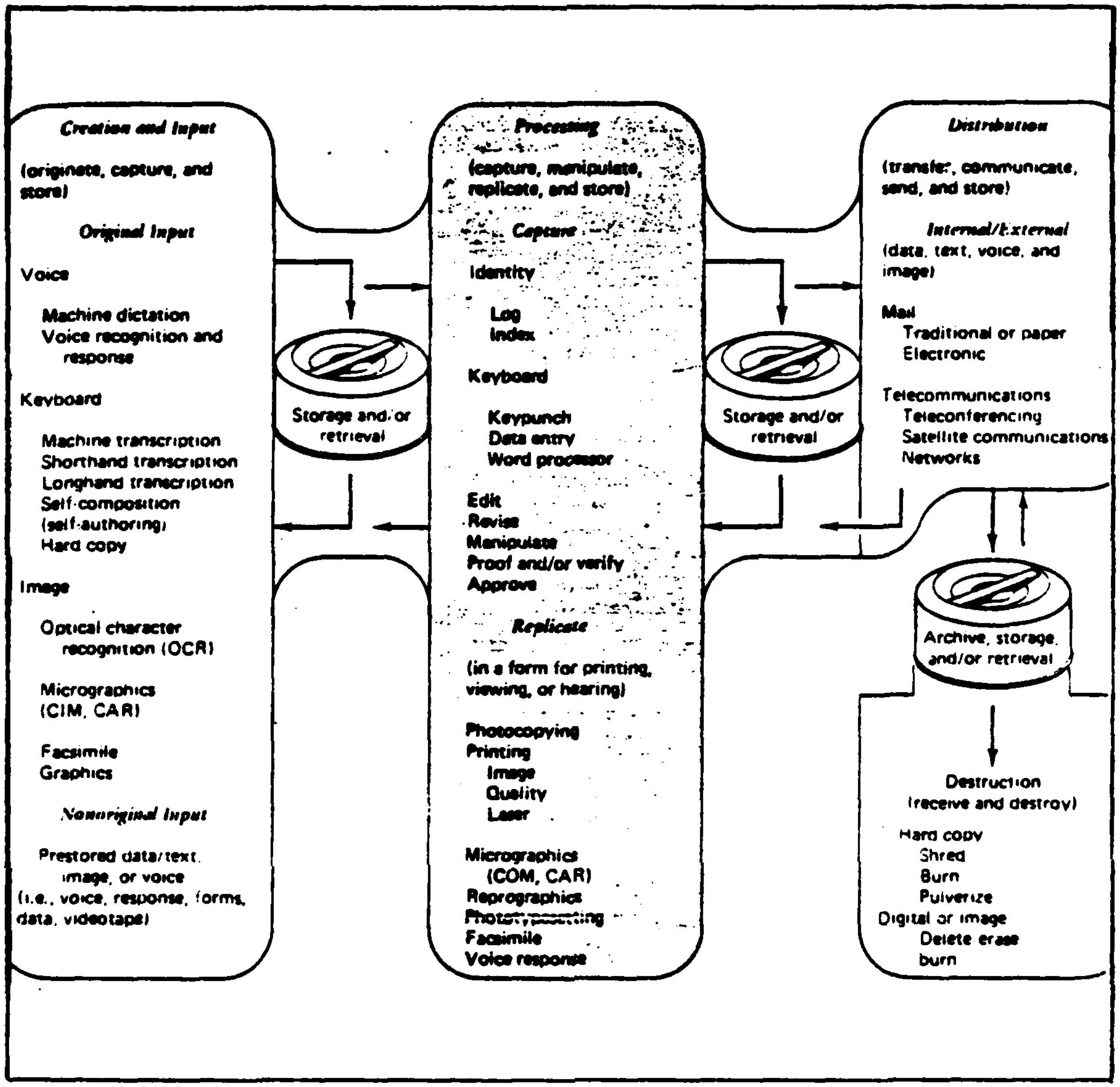

Figure 3.1 The processing component of the information flow.

C. WORD PROCESSING

First of all, distinctions must be made between data processing and word processing. Data processing usually, as was mentioned previous section, deals with the manipulation of numbers through various computation to deliver meaningful totals and create useful statistical information from raw numbers. Word processing, on the other hand, manipulates information in language through entry and revision, to make the originator's meaning clearer to the intended recipient or audience. It changes words and their sequence, as well as their presentation, but it does not add new intelligence.

The fundamental distinction between word processing and data processing is that *Data processing* deals with numerical data and *Word processing* deals with alphacharacters in text form. *Word processing* focuses on communication (written or oral) between two or more people. *Data processing* acts more upon statistics and tabular data (figures, account numbers, lists, and so on). Data processing tends to be repetitive and performed periodically (end-of-month billings), and the output tends to appear in a specific format (computer printout form). See Figure 3.2 for comparison of **some basic distinctions. [Ref. 9: p. 104]**

Word processing, as a function, is a type of automation technology. The word processor, as a unit, is a device which handles and performs word processing services. The term word processing was an IBM invention in 1964 as a way to market a typewriter which could record words on magnetic tape. [Ref. 10: p. 1573]

There is a large variety of word processors available on the market today offering a multitude of features which include global search and replace, sort, move, copy, insert, deletion, math, records processing, programmability, communications, spelling check and mailing lists. Generically, they consist principally of keyboard, display unit, a computer, and one or more removable storage devices in the form of disks, diskettes, tape units, or magnetic cards.

Word processors are designed to simplify the production of documents by eliminating the repetitive tasks of typing, editing, and outputting. Additionally, many word processors offer extensive formatting capabilities and some limited data processing applications. They are most useful in the production of documents that are heavily revised, frequently reissued after initial distribution, forms-oriented, and lengthy documents that require extensive editing.

The various forms of word processors include stand-alone systems, shared-resource systems, shared and distributed logic systems, cluster systems, and software packages for mainframe or micro-computers. [Ref. 11: p. 24]

Stand-alone systems consist of a single, self-contained terminal housing the operating system, the software package and the disk file. It is entirely independent and does not rely on a central processor for its functionability nor does it share any functionability with any other system.

Share-resource systems are essentially stand-alone systems sharing peripheral devices such as printers, which can be expensive and may represent a large portion of the individual stand-alone purchase price or the total cost of shared-logic system.

Characteristic	Data Processing	Word Processing
Type of information	Processes data	Processes words
Primary applications	Numerical calculations for payroll, inventory accounting, billing airline reservations, large mailing lists, and so on	Creating and revising letters, memorandums, news releases, small mailing lists, in-house publications, and so on
Turnaround	Usually 24 hours or longer (depending on application)	Usually 2–4 hours (depending on application)
Quality of output/print	Usually of draft quality	Usually of professional letter quality
Processing information	Acquires data, manipulates it, and provides decision, tabular report, or completed forms for management	Acquires data and/or text, manipulates it, and provides final output documents (reports or correspondence for management)
Scheduling	Strict schedules: user must fit the system	Flexible schedules: fits the needs of the people
Priorities	Applications giving highest return on cost	Priorities by urgency of documents
Personnel	Computer operators, programmers, systems analysts. Highly skilled, technically oriented, work alone, not people-oriented.	Administrative secretaries, correspondence secretaries, WP supervisor/manager/coordinator; highly skilled, people-oriented.
Corrections/revisions	Must fit into schedule	Must meet turnaround needs

Figure 3.2 Word processing and Data processing distinctions chart.

A shared and distributed logic system shares software, files, logic, workstations, and printers with all the attached terminals. It can handle concurrent data and text processing, massive on-line storage, programmability, and even development of a text

data base. Advantages of the shared/distributed logic system include more on-line storage, more sophisticated software, superior functionability, job sharing, minimal media handling, and standardization. The major disadvantage is its vulnerability to total breakdown, that is if the central processor goes down, all terminals become inactive.

A cluster system combines stand-alone, shared-resource, and shared-logic system technology offering flexibility and access to both files and resources. Advantages of this configuration include excellent growth and expansion capabilities as well as inclusion as part of local-area networks, which may include several kinds of workstations attached to one central processing unit, electronic file cabinets, printers, and so on. Disadvantages are primarily standardization and degradation of response time.

Software packages are available for installation on mainframe computers as well as micro and personal computers. Basically code intensive and less functional than dedicated word processors, software packages are best suited for applications requiring minimal word processing.

Other applications of word processors permit the handling of large document processors. In the advertising industry a word processor with graphic capabilities may be used to create total composition of individual pages, including text manipulation, electronic cropping, and placement of graphics and half-tones within text. Word processing terminals when installed with communications packages may also be used for electronic mail. Phototype-setting and photocomposition are also within the capabilities of word processors as well as the employment of optical character readers.

D. PERSONAL COMPUTERS

Recently, some data processing and word processing capabilities, have been growing in a different way. Low-cost personal computers have proliferated in many organizations without the awareness or approval of either top management or data processing and word processing management. Users acquire them to meet a need, but they seldom become a part of an organization's integrated approach to office automation. The personal computers usually serve only one user well, that is the user can work more effectively with a personal data base and does not require the exchange of data with the daily mainstream business data processing operations. [Ref. 9: p. 107]

Personal computers have moved into the business environment in large numbers, especially for use by managers and professionals. The development of the microcomputer, followed quickly by the personal computer, has heralded a new level of calculating and processing routine transactions in the office.

The personal computer represents a major development in OA in that it can be used as a terminal to access larger computers and their data bases, thereby, expanding the network. Linking personal computers to mainframes not only increases the power of the PC but often frees the mainframe for the massive data handling for which it was designed. Joe Farelly, Applied Data Research (ADR) Vice President, states:

> Mainframes are often fully loaded and at the same time inefficient in performing certain tasks. These can include editing, prompting, graphics, data manipulation, and data and program browsing. Off loading these functions to the PC makes both the mainframe and the PC more effective. [Ref. 12: p. 16]

In addition, many people are buying personal computers for hobby purposes, but use them in the business environment. The placing of such systems in homes can be the forerunner of what has been termed the *peopleless office, whereby employees have their terminals at* home. They receive, process, and return their work via their terminal and thus avoid travel costs.

For the present, the greatest benefits of personal computers are likely to be achieved by those individual employees whose applications are personally or departmentally critical but do not require corporate wide information or communications.

E. OPTICAL CHARACTER RECOGNITION (OCR)

One of the fastest methods of input, and most discussed in today's office, is OCR (optical character recognition). OCR can be defined as the process by which a system scans typewritten pages and stores the scanned characters in digital form. OCR devices can scan and read printed or typed characters and convert them into storage or input directly to word processing or data processing screens, for immediate editing or formatting.

In the past this involved the use of special type of fonts which could be easily recognized by a OCR reader. Today's OCR units are capable of reading all the standard IBM electronic-style typefaces: ten and twelve pitch Courier, twelve pitch Letter Gothic, ten and twelve pitch Prestige Elite, ten pitch Prestige Pica and more

[Ref. 13: pp. 48-52]. This has allowed one type of optical scanning equipment, the OCR page reader, to become a productive tool in the business world. The basic premise behind adding an OCR unit to a word processing installation is simple. By generating first-draft copy on typewriters, then reading the hard copy into the word processing system via a OCR unit, the relatively expensive word processing workstation is used for what it does best and most productively; the revision and manipulation of text. In addition, it eliminates the need for expensive and time-consuming word processing training. As more firms convert from paper files to electronic files, the OCR units will become even more essential as a means to enter paper documents into electronic files without time-consuming keyboarding.

Today OCR is accepted as a mature technology with a proven track record of cost reduction in the highly labor-intensive area of data entry. The greatest advantage of OCR lies in its power of interface with other technology in the modern office. In addition, OCR permits the capturing of input data at the point of organization. Through conversion to digital impulses at that point, OCR eliminates the need for again keying the same information before entry into word processing operations. However, most input material must be in a form that can be read by the OCR scanner. More recently, OCR units have been introduced that reduce the formatting requirements. [Ref. 14: p. 95]

F. COMPUTER ASSISTED RETRIEVAL (CAR)

Retrieval is the recalling of stored information for reuse. The storage and retrieval function can be performed through either manual or electronic systems. Manual retrieval is accomplished via an indexing system that uses alpha, numeric, topical, or color coding systems to locate the needed material. The manual systems involve extensive labor. For example, to find information in a given file, an office employee would have to:

1) Determine how an item is indexed and classified.
2) Go to the files or storage area.
3) Look for the appropriate file folder.
4) Retrieve it.
5) Prepare a manual record of the retrieval of the file folder, and place this record in the file in place of the folder.
6) Eventually return it to the storage area.

By contrast, the on-line system involves only keyboarding key words and viewing the desired material as it appears on a screen. [Ref. 9: p. 56]

Electronic storage and retrieval is accomplished from on-line memory. Information is directly stored in the central processing unit (CPU) of the computer for instant recall by the proper code. This automatic filing system within the computer can use alpha, numeric, or topical coding. Computer-assisted retrieval (CAR) can also be accomplished through CIM (computer input microfilm), COM (computer output microfilm) and other micrographics systems.

Managing information and storage retrieval systems requires controls, including procedures for indexing, securing, accessing, modifying, retrieving, and purging. As an outgrowth of the need for flexibility, data base management systems (DBMS) are being developed as an affordable software for smaller computers. In the past, DBM systems, costing from $50,000 to $200,000, were packaged for large computers. A newer approach is to provide the flexibility of the large-computer DBM systems tailored to microcomputer capabilities, thereby reducing costs to fit the growing market.

Data base software can significantly reduce the costs of information storage and retrieval in several ways. *DBMS*: 1) maintains an internal data directory, keeping descriptions of data and relationships among the data, 2) allows data to be accessed in a form that is appropriate, rather than forcing a new program to be written, and 3) provides great flexibility and economy in altering the initial system to meet new needs. It is important to note that the storage and retrieval functions may occur at various points within the flow or cycle with different applications and configurations of the integrated office. There may be some variation in the same office from time to time, depending upon deadlines and other tasks to be performed. [Ref. 9: p. 57]

CAR systems may be put together with a mainframe, a minicomputer, or even a microcomputer. Essentially, computer-assisted retrieval of microfilm is a two-part process. The microfilm is used to store and display database information, and the computer is used as an interactive logical search processor to provide fast and security storage and retrieval. Another approach is to store the search parameters in the computer along with the location of the microform. Figure 3.3 shows how a combination of technologies may be used to improve productivity and more efficiently handle information. The growth outlook for CAR with other integrated information systems is very good. It is expected that future CAR systems will be modular, so that word processing and electronic mail can be added. [Ref. 9: pp. 224-226]

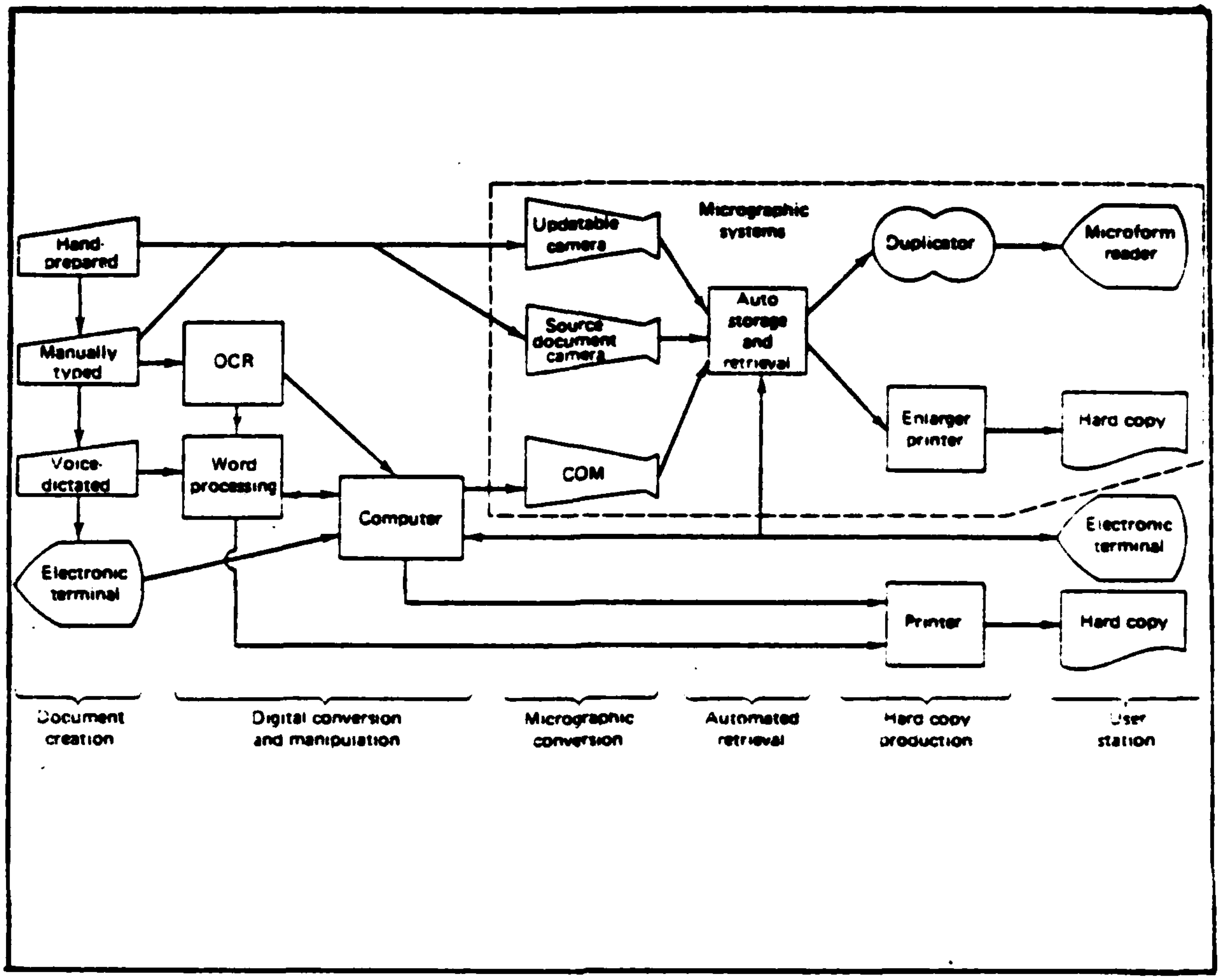

Figure 3.3 A look at future information retrieval.

G. ELECTRONIC MAIL AND COMPUTER MESSAGE SYSTEM

Electronic mail, a primary medium of internal communication within a company, is capable of conveying audio, data, text, graphics, or hybrid modes of information between users [Ref. 15: p. 48]. It can be anything from two telephones to one of the many advanced computerized message systems currently being marketed. It can extend externally from the office to almost any location in the world. Communication may be synchronous or asynchronous, computerized or noncomputerized, and may consist of single mode or multimodes configurations.

Mail forms an integral part of an office automation system, and in many cases electronic mail is one of the first applications implemented. Basically, it is a system whereby users can send and receive mail to and from any other user in an organization.

This is done via workstations, word processing systems, micros, or computer terminals which are connected to the office communication system. Usually, a user has a mail station number or electronic in-basket which holds the mail until it is downloaded by the recipient. Electronic mail can serve as:

1) An electronic distribution mechanism for written communication produced by, or passed through, word processing.

2) A filing and retrieval mechanism for originators and recipients of written communications utilizing both on-line and archival file storage.

3) An easy and fast method of communication for users.

4) A method of reducing the overall handling of paper to improve work flow, thus increasing the efficiency and cost effectiveness of corporate communications. [Ref. 15: p. 49]

Electronic mail and electronic message systems basically provide the same functions with the main difference between the two being that electronic mail is a more formalized system which uses text processing to format the content of the mail. Electronic mail, when implemented, needs to fit the existing office environment and must have a "friendly" user interface. Ideally, it should, to some extent, operate in the same way as the existing paper mail system. Tools such as calendar management and meeting scheduling are ancillary services to electronic mail.

H. MICROGRAPHICS

Micrographics are defined as the capture, retrieval, and display of miniaturized, high resolution photographic images, either as text or graphics. It provides quick and inexpensive duplication of documents for distribution, viewing, and recreation of hard-copies of microforms.

Micrographics provide for compact storage of files. With an array of film types, techniques, and retrieval capabilities, micrographics afford many benefits:

- Economy of document and file creation,
- Economy of duplication,
- Rapidity of duplication,
- Economy of distribution,
- Reduction of filing costs,
- Reduction of misfiling,
- Compact storage,
- File integrity,
- Speed of retrieval,
- Economy of retrieval,

- Portability,
- Protection of vital records and disaster recovery,and
- Backup of on-line files. [Ref. 9: p. 126]

Basic limitations for micrographic use are that microfilm provides no space for annotation and the viewer must have a terminal.

I. TELECONFERENCING

Teleconferencing having existed since the days of the telegraph and telephone is perhaps one of the oldest forms of automation technologies effecting office automation. Teleconferencing is the use of telecommunication systems to enable a group of three or more people, at two or more locations, to confer with one another [Ref. 16: p. 251]. Obviously, there are numerous means by which such communication can be performed and different authors break them down in a variety of ways. For our purposes here, only three forms will be addressed: audio-conferencing, video-conferencing, and computer-conferencing.

In the form of the conventional telephone conference call, audio-conferencing is almost as old as the telephone. It requires all participants regardless of location to take part simultaneously. Audio-conferencing may be enhanced with the augmentation of graphics equipment such as facsimile or two-way electronic blackboards, but they too must be simultaneous.

Video-conferencing is much more complex and expensive than audio-conferencing but offers much more in terms of user interaction and participation. It provides a means for personal communication through face-to-face meeting, verbal communications through the use of the telephone, and visual communications through written format such as letters and memos. [Ref. 17: pp. 24-25]

Computer-conferencing, which is very similar to electronic mail, permits participants to conduct meetings throughout scattered geographic locations. Using the communications networks, conferees can access, read, and respond with others regardless of whether the others are communicating simultaneously or not.

J. PROFESSIONAL WORKSTATIONS

The primary device in the automated office for the office worker is the workstation. The capabilities of a workstation will vary depending upon user requirements. A managerial or professional user will require different functions than that of a secretary or a clerical worker, and the professional may require a workstation

that is less than half the size of many of today's computer terminals. The workstation must meet the basic operational needs of a professional to obtain satisfactory results. These may include:

- Ability to handle various forms of data including voice, image, and text,
- Programmable,
- Easy to use,
- Able to perform basic accounting functions as well as financial modeling, and
- Ability to communicate in all forms to other users.

Workstations which are provided for secretarial or clerical staff will tend to have similar functions as the professional workstation but in reduced format. In addition, they should be controlled as to the level of access to information, services and other users.

K. LOCAL AREA NETWORK (LAN)

The most dramatic advance in office automation technology has been the ongoing development of methods and devices to interconnect data processing, word processing, dictation systems, OCR, micrographics, phototypesetting, management workstations, records management--all of which have developed separately and with their own technology. Telecommunications is the medium whereby all of these separate technologies will become interconnected. Through it, information introduced into one device will become available to every other device on the network.

A network is a system that interconnects a wide assortment of information processing devices (computers, text processors, files, printers, OCR, etc.) through a communications line or data base. The advantage of networking is that it allows information to be sent to or shared among all points on the network. It allows workstations on the network to access common files or local ones, and information to be sent to all or selected points on the network. [Ref. 9: p. 135]

The identification of the importance and benefits of networking has caused a growth of interest in local area networks (LAN). A local area network is a communications network that provides interconnection of a variety of data communicating devices within a small area [Ref. 18: p. 2]. The distance limits are imposed by the technical characteristics of the system, and range from 1500 feet up the three miles. The potential for increased office productivity is tremendous. [Ref. 9: pp. 134-139]

There are three elements of significance in this definition. First, a local network is a communications network, not a computer network. Second, it interprets the data communicating devices broadly, to include any device that communicates over a transmission medium. Examples are:

- Computers,
- Terminals,
- Peripheral devices,
- Sensors (temperature, humidity, security alarm sensors),
- Telephones, and
- Television transmitter and receivers.

Of course, not all types of local networks are capable of handling all of these devices. Third, the geographic scope of a local network is small. The most common occurrence is a network that is confined to a single building. Networks that span several buildings, such as on a college campus or military base, are also common. A borderline case is a network with a radius of a few tens of kilometers. With appropriate technology, such a system will behave like a local network. [Ref. 18: p. 2]

Careful planning is required to achieve the desired results and to meet the needs and applications. Important areas of planning include the topology or structure, and the manner of transmission. Networks are characterized by their topology and by the physical transmission media. An understanding of these areas provide a broad perspective of future telecommunications.

1. Topology

The topology is the physical and logical structuring or configuration of the network: in other words, the way in which devices are connected to one another and to the traffic processing system. Computers and various types of terminal devices are generally interconnected in one of three major arrangements, or topologies: the star network, the bus network, and the ring network.

The oldest arrangement, called the star network, or hub, passes all communications through some form of switcher at the hub of the configuration. Individual devices have no direct connection with each other. The hub may be some form of central processor, such as a private branch exchange (PBX) or a mainframe or host computer (see Figure 3.4). As with any centralized controller, a problem at the hub or CPU can create problems throughout the network. Figure 3.4 shows star network.

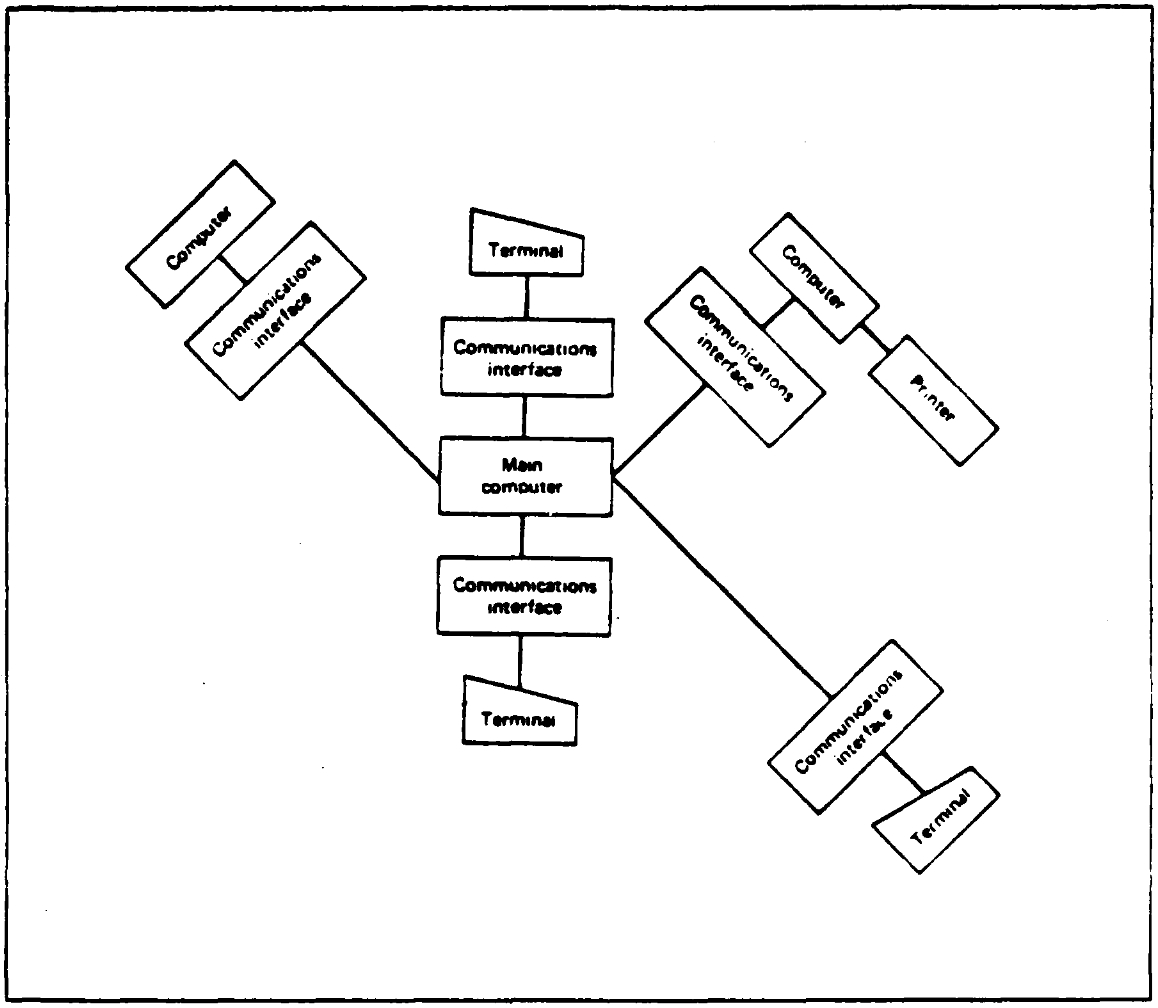

Figure 3.4 Star network.

The ring network topology connects individual devices in a loop or ring, via a string of signal repeaters. A signal repeater at each station or mode on the net permits signals to travel greater distances. However, this system resembles in operation some kinds of Christmas tree lights. Figure 3.5 shows ring network.

If one device in the ring goes down, the entire network is out of operation. That also means that the entire network is down each time a new device is added to the ring. A ring network is capable of using fiber optic cable for high-performance transmission.

The bus network consists of a length of coaxial cable (called a "bus") to which individual devices are attached by means of simple cable taps. Note in Figure 3.6 the manner in which devices tap into the communications cable, as compared with the

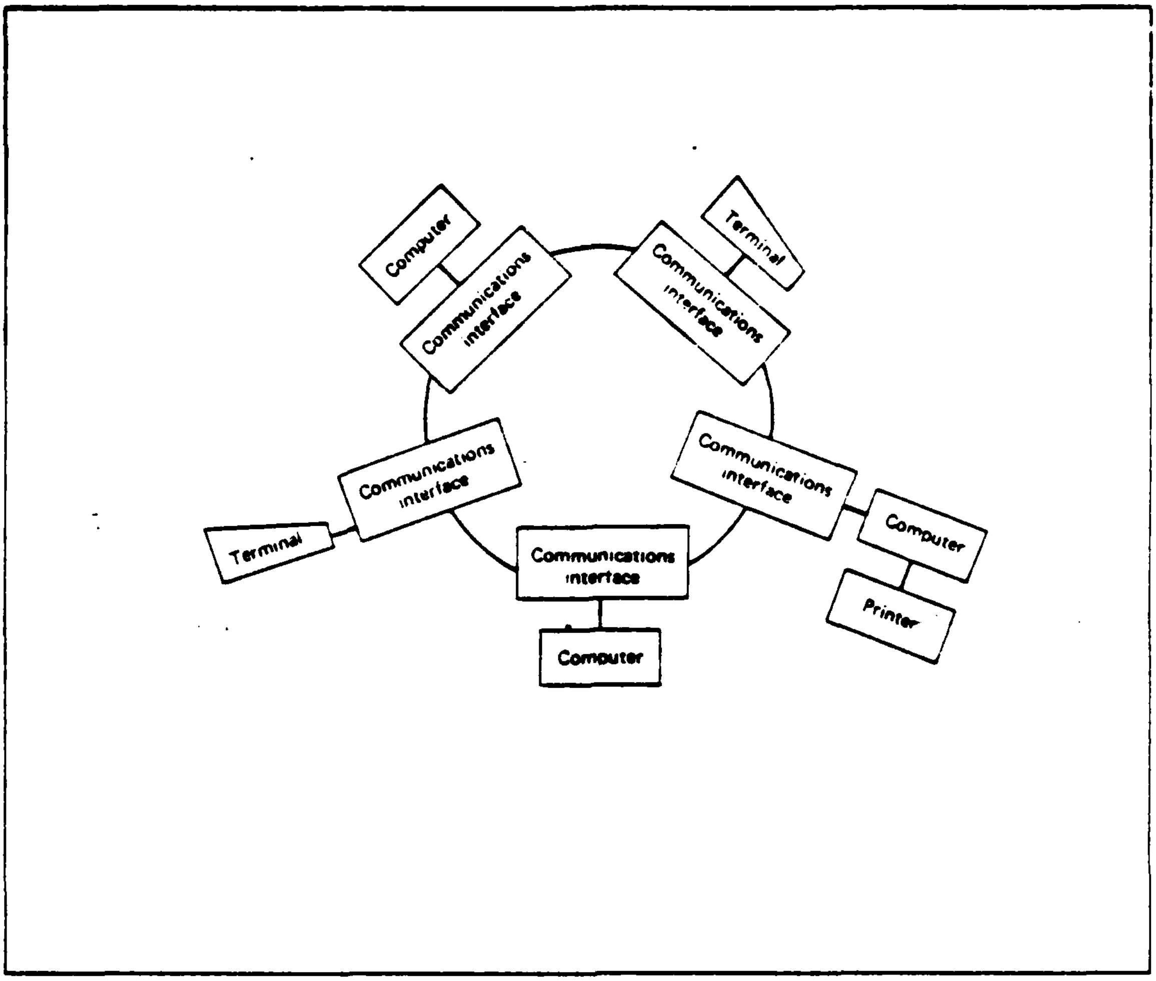

Figure 3.5 Ring network.

manner in which they go through the devices in the ring network illustrated in Figure 3.5. There is no centralized center hub and signals from one station move along the bus in both directions to all stations tapped into the cable.

The advantage of the bus network is its high reliability because there are no active components such as repeaters along the transmission line. The failure of one station has no effect on the rest of the network's operations. There is no downtime when new stations or devices are added to or removed from the network. Its disadvantage lies in its present inability to use fiber optic cable, although whether this is a true disadvantage depends upon the applications and needs of the organization.

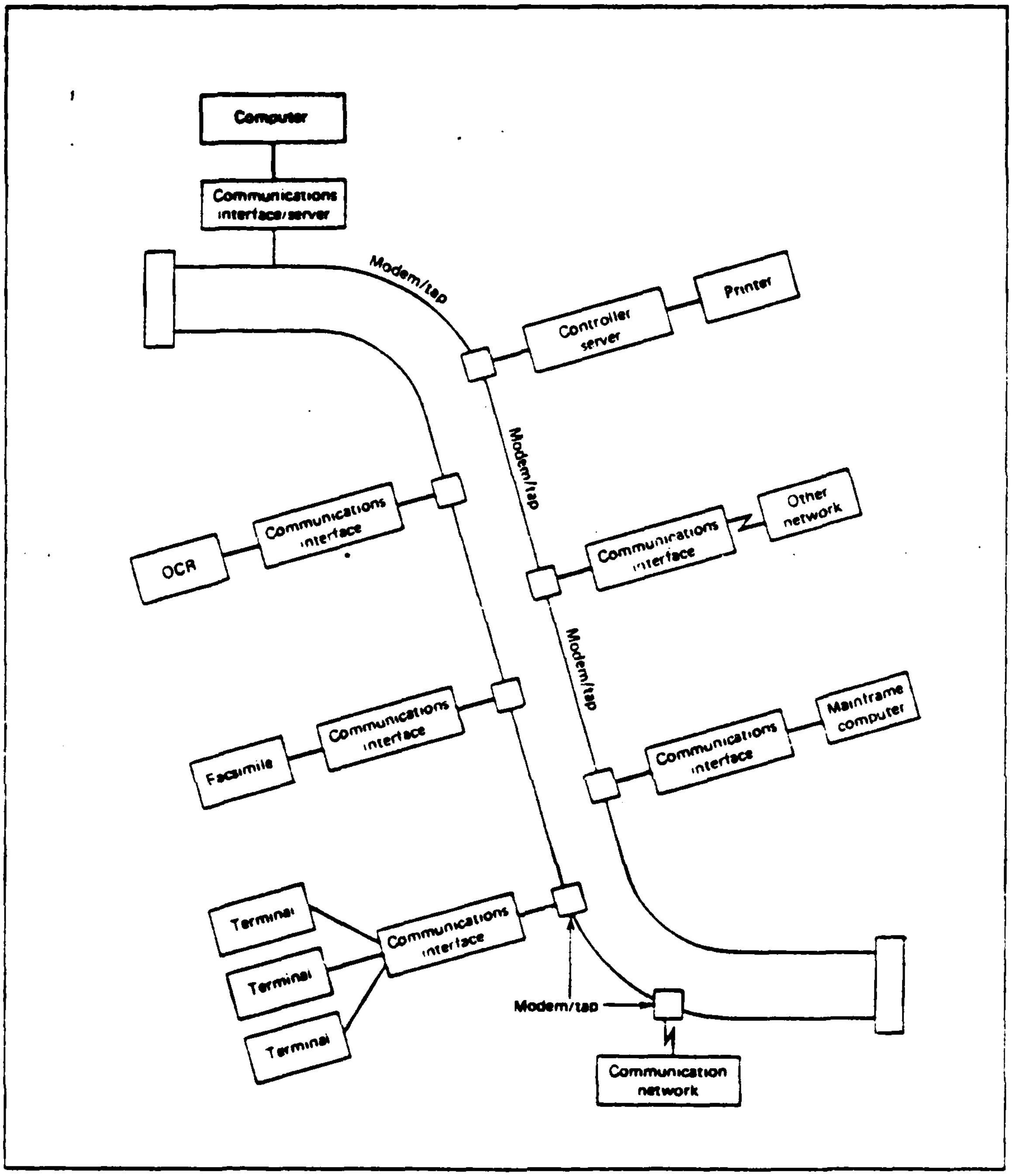

Figure 3.6 Bus network.

2. **Physical Media**

Essentially, there are three major forms of physical media for the transmission of data twisted-pair wiring, baseband single channel cabling, and broadband multichannel cabling.

Twisted-pair wiring is used in telephone-type PBX systems. Its future and that of fiber optics, already in use by AT&T in local are networks, is very likely related to the recent deregulation of AT&T and the products marketed by American Bell Inc. (ABI). ABI has announced its advanced information system/net 1 service, which has software to handle protocol conversions necessary to link previously incompatible terminals. The company has estimated it could perform these conversions for 84 percent of all terminals on the market.

Baseband networks involve systems using one digital pathway ranging from around 1 million bits per second to 50 million bits per second. Baseband systems allow a single stream of data to be transmitted on a communication medium. Baseband systems support one channel or path at a time. Baseband networks typically use a three-eighth-inch coaxial cable with carrier wire surrounded by copper mesh. There are both advantages and disadvantages to baseband. Advantages are that the cost of cable is relatively low, reconfiguring the network is easy, network interfaces are inexpensive, and the technology is quite simple. Disadvantages are that the network has a limited scope of application, the number of devices that can be attached is also restricted, completely on-line communications eliminate network availability, and transmissions are subject to a fluctuating quality that is not conducive to voice communications.

Broadband differs from baseband in a number of ways. Broadband uses common cable television (CATV) cable, is analog, and employs modems. Broadband signaling allows multiple streams of data to be transmitted simultaneously at different frequencies on a communications medium, usually coaxial cable. Advantages of broadband include a higher bandwidth, which enables the network to handle data, voice, and video; flexibility and multifunction ability; and easy expansion and reconfiguration capability. Disadvantages relate directly to cost. Broadband brings with it the high cost broadband modems, additional hardware requirements, and a possible overdependency on one network for voice, data, and other services.

The terms broadband and baseband as related to local area networks define only the medium, not the application, and both must be considered when determining the design of a local area network. The baseband and broadband local network approaches differ primarily in their transmission throughput capabilities and their associated cost. The ultimate basis for comparing thes facilities is their ability to effectively perform the required applications in a specific office situation. Neither approach is inherently superior; each has its place, according to needs. Where large

volumes of data need to be transferred quickly from one large computer to another, or where realtime video data is needed, the extra cost of a broadband local network may be very worthwhile. Where office communication consists of intermittent to moderate data from a large number of small office workstations, a baseband local network may be the best choice. [Ref. 9: pp. 139-143]

L. FACSIMILE

Equipment for transmission of hard copy information via telephone lines has been available for some time. Physically, a facsimile (FAX) machine is similar to a photocopier; however, its operating principle is entirely different. In simple terms, it converts a picture to a string of electronic signals which can be sent over a telephone wire. At the remote end, the signals are converted back into a picture. Since the signal travels over the telephone network, any two locations with a telephone can communicate using FAX, providing two compatible machines are installed at each end.

One of the main characteristics of a facsimile system is its speed the faster the transmission, the lower the transmission costs. Three standard speeds are currently in use and the equipment is classified into three groups accordingly. Group 1 is the slowest and group 3 is the fastest requiring the most expensive equipment. Many group 3 machines include a range of additional facilities, such as auto-answer, so that they can accept transmission when unattended, picture size variations, and local copying. Generally, group 3 machines can also operate in the group 2 and group 1 mode.

M. SUMMARY

The tools of automation discussed throughout this chapter are the primary means by which the work in automated offices are performed, but they are far from being inclusive. Advanced discussions could include such items as copiers, terminals, graphic displays, card and tape readers, software, languages, computer-assisted instruction, CRT display, typesetting, information packaged services, decision support system packages, or complex networking systems. Some of these technologies will become obsolete over time and others will evolve which transcend the present levels of automation. The keys to successful offices of the future will be flexibility, careful planning, and a continuing education process in how the tools of technology can help expand and improve man's horizons of productivity. Each organization must evaluate itself to determine what automated office tools are required and the best approach to integrate these tools into the office area.

IV. INTRODUCTION TO THE ROKAIC

A. GENERAL

As seen in Chapter III, there are many alternatives available for the design and construction of an automated office. In this chapter, I will describe the mission. organization and computer center of the ROKAIC. The work flow in the offices of the ROKAIC is described. I will also discuss the problem definition and the feasibility study using the structured system analysis methodology.

B. MISSION AND ORGANIZATION

1. Mission

The primary mission of the ROKAIC is to assist decision makers who are responsible for preventing North Korean aggression.

The additional missions are :

- Information collection from North Korea and other hostile countries.
- Analysis of collected information.
- Dissemination and management of analyzed data.

2. Organization

The ROKAIC consists of six divisions, two offices, a computer center and nine subordinate commands, located in Seoul, Korea. The majority of the work effort at ROKAIC is performed by the intelligence and analysis divisions at the headquarters location. The administration. operation. logistics. and communication divisions support the intelligence and analysis divisions. The organizational structure is outlined in the organizational chart shown in Figure 4.1 .

C. COMPUTER CENTER

1. Organization

The computer center is divided into three parts as shown in Figure 4.2 . The planning and administrative services section
is responsible for, among other things, (1) procurement, installation, and maintenance of required software and hardware in support of the current computer system and (2) co-ordination with other division staffs and contracts with equipment vendors from outside.

The support and management section is responsible for:

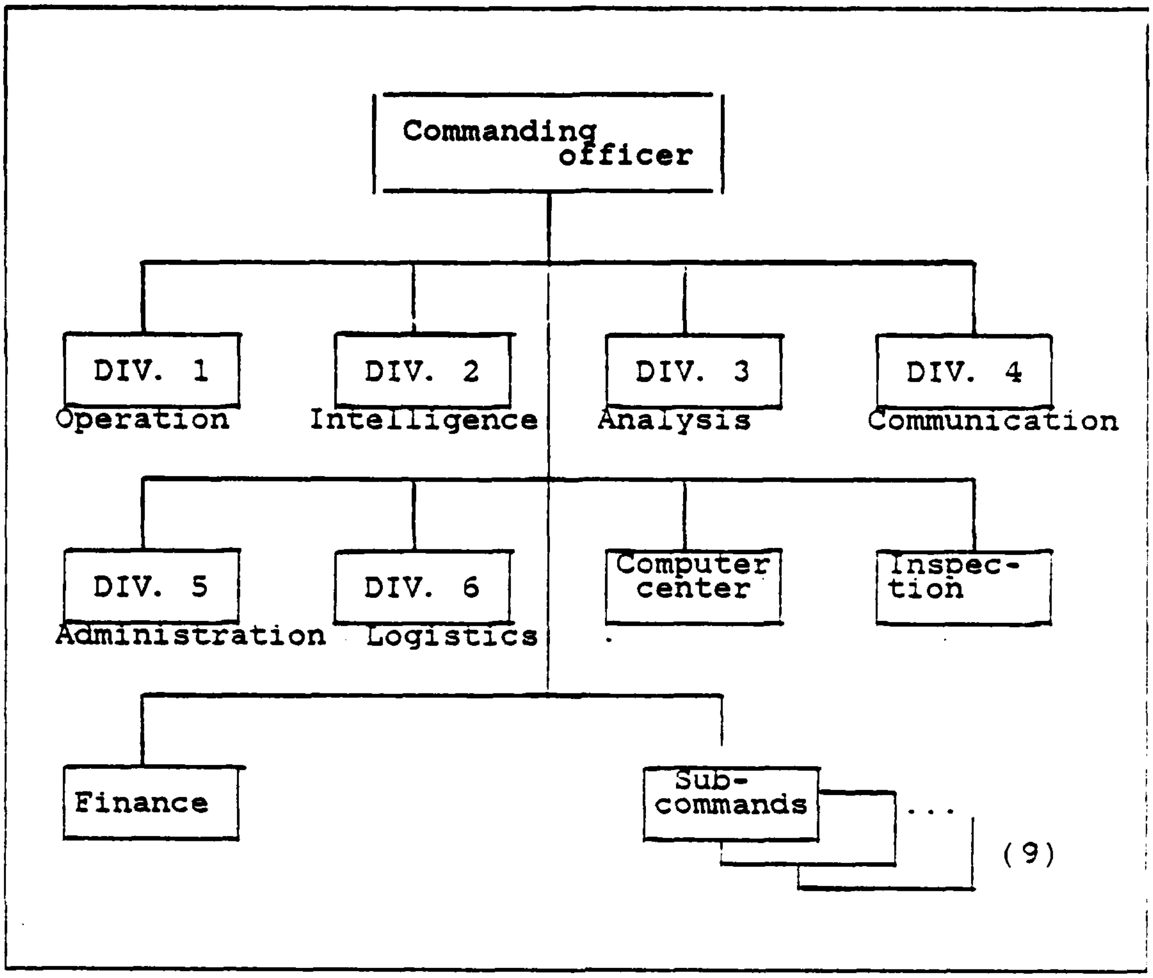

Figure 4.1 ROKAIC Organizational Chart.

(1) supporting appropriate data from user requirements,

(2) updating of mainframe databases.

The research and development section is responsible for (1) operation of the current system; (2) improvement of managerial effectiveness and continuous development of system technology. This section is also charged with operation and management of the computer equipment room.

2. Configuration

The computer center of ROKAIC currently has a Prime 850 system (mainframe) with a main memory of 4 megabytes and 1200 megabytes of storage available on disk. It operates the CODASYL database management system (DBMS) and also has a micro-fiche system interfaced with the mainframe. The mainframe

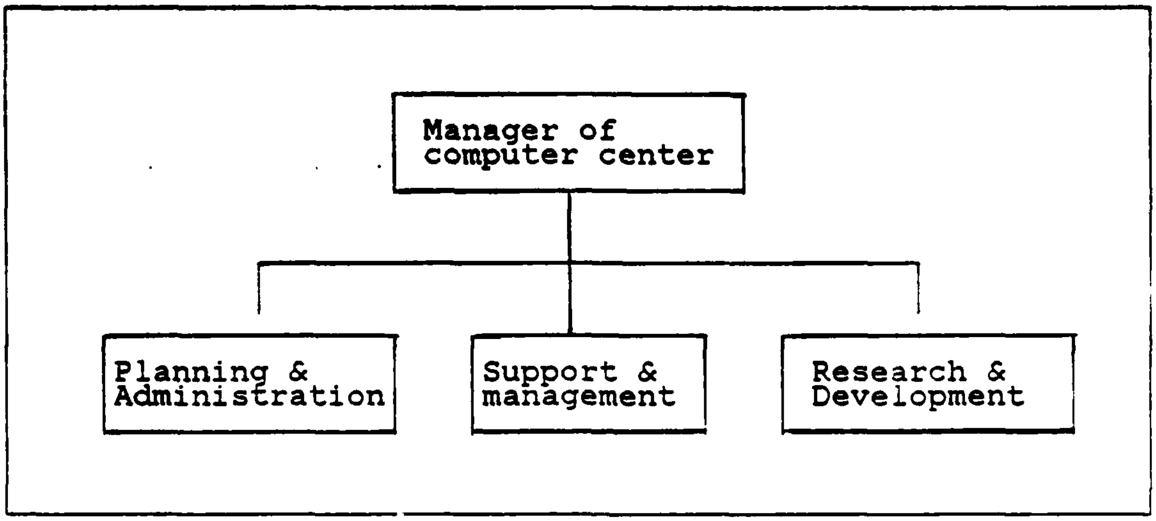

Figure 4.2 The organization chart of computer center.

connects with 15 CRT terminals, two magnetic tape units, printers, data-100 input devices and the micro-fiche output device. Two CRT terminals are connected to the intelligence and analysis divisions.

The micro-fiche system stores all documents (original papers). The microfiche can be retrieved by keyword or title in computer memory.

The configuration of computer equipment is shown in Figure 4.3 .

D. THE WORK OF THE CURRENT OFFICE

As mentioned in the previous section, the intelligence and analysis divisions perform the main tasks in the ROKAIC. They produce several kinds of information documents from data collected from various sources. However, they do not use computer facilities.

The daily information document, for example, is produced by the procedures shown as "work flow procedures" in Figure 4.4 . The data is collected from sources such as radio broadcasts from North Korea, mainland China, the USSR and other countries; North Korean TV, advanced military bases (observation), aerial photographs and other sources such as interrogation, etc. Data collection goes on from 01:00 to 24:00 everyday. The professional intelligence officers analyze and update the information in their manual files and sometimes make use of data stored in computer memory. They produce a temporary daily information document using the typewriter and manual files compiled overnight.

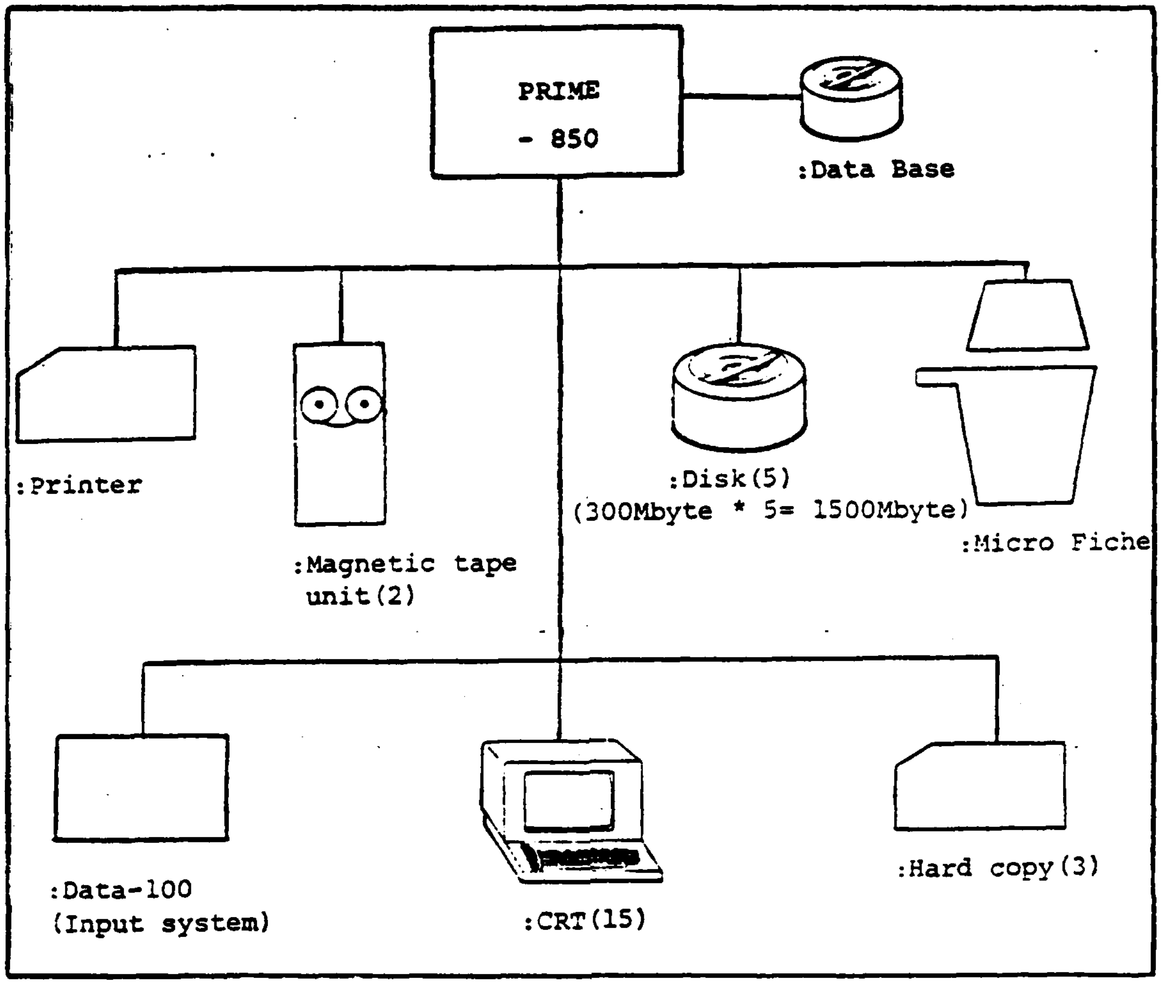

Figure 4.3 The configuration of computer equipments.

They never use computer facilities (terminal, etc.) to produce intelligence documents. They do not know how to use computer facilities at all. They can't make use of the computer system because the existing system does not have word processing software and networking yet. Also, they do not know how to operate the computer system. Nobody knows how to do that except the computer personnel.

After an intelligence officer makes a temporary document, he sends the document to the commanding officer by the chain of command. The document often is updated with the opinion of the senior officer at each level of the chain of command. Finally, after the commanding officer approves the document, it is printed and distributed. The document is distributed to the Secretary of Defense, the chief of staff (of the Army, Air Force and Navy) and the National special agency within one hour. This procedure

Time	Work Flow
08:00 – 24:00	1. Collection/Analysis of intelligence data from the following resources. a. Listening to broadcasting from North Korea, mainland china, the soviets b. Advanced military base (observation) c. Aerial photograph d. Others (interrogation, etc.)
24:00 – 05:00	1. Professional officers: a. Updating/Compiling of collected intelligence data b. To make (temporary) intelligence document by using typewriter c. To report to senior officers
05:00 – 07:30	1. Senior officer --> Division staff --> C/S --> Commanding officer a. Review of document content in each step b. Modification (add, delete, correct, etc.) c. authorization of commanding officer
07:30 – 08:30	1. This document is published at the publishing office : Editing Information Document
08:30 –	1. Distribution to: a. the Secretary of Defense b. the chief of the Army, Navy, and Airforce c. the Field Commanding officer d. Each division and computer center (inside)

Figure 4.4 Work flow procedure of current office.

seems like war every morning. It is very complex, and takes a long time. After the document is printed, computer personnel input the title of the document to the mainframe via a data-100 input device. The document is then stored in micro-fiche format.

E. PROBLEM DEFINITION

ROKAIC spends roughly $8,000/month to operate the computer center, but still doesn't take full advantage of computer efficiency. The computer system is operated from 08:00 to 20:00 daily. The main tasks performed by the mainframe are to collect input data and compile it and store it for future retrieval. In my judgment, ROKAIC does not make use of much more than half of the computer's capability. ROKAIC does not know how to make most efficient use of the computer. The office has never done a cost/benefit analysis of the existing computer system. Despite the enormous amount of money spent on the ROKAIC mainframe computer, the system remains unused during most of the night. At the same time, many intelligence analysts are awake, using the typewriter and handwritten notes to produce the next day's intelligence report.

As mentioned in the previous paragraph, the problems with the existing system include:

1. The computer system does not have an on-line document editing system.
2. Lack of data accuracy and ineffectiveness of work due to non-integrated data updating by manual procedures. Not using the computer during editing and too much time using the typewriter.
3. Wasting manpower and time due to manual processing and complicated work procedures.

F. FEASIBILITY STUDY

1. Objectives and Scope

As mentioned, in the previous section, the existing computer system has serious problems. The most serious problem is that it still does not take full advantage of existing computer technologies. The basic problem is that this system is not composed of modern OA technology and tools. The current system needs specific changes to obtain optimal performance of computer facilities.

The main objective of the existing computer center should be to develop an on-line document editing system. We also need modern office automation technology and tools to make efficient and effective use of the computer system. The following objectives must be established to develop the existing computer system into an integrated OA system.

The first step: store data in electronic form (rather than written form, and retrieve it electronically. Convert manual files in file cabinet to electronic files.

1) Use more keywords for greater cr s reference

- **search by keyword**

- store by keyword

2) Retrieve by more keywords

3) Produce printed copy on demand

4) Reduce paper by 25 %

5) Reduce filing clerks by 35 % - 40 %

The second step: Implement word processing technology

1) Improve office services (accurate records and speed)

2) Reduce typists by 30 %

The third step: Establish a long range plan to develop current office services to integrate office automation systems continuously.

1) Voice data entry.

2) Voice keyword analysis.

- quick response
- Intelligence (real-time)

3) Decision support by the decision support system (DSS) technology.

When the above objectives are accomplished, we can also remove current problems.

We have to develop a step by step project to accomplish the objectives mentioned above. The scope of the first and second steps' projects will not exceed $10,000. And we also have to have a project team (3-5 people) which includes analyst and users. It should not exceed 30 man-months of programmer/analyst effort. We might need outside consultants. They may provide specialized experience or skills not possessed by the present staff. They may also provide expert opinion to support or reinforce a plan or recommendation that is presented to management. After completing steps 1 and 2, we have to expand to step 3 to construct better office automation systems in the future.

2. Study the existing system

A questionnaire was sent to office personnel at ROKAIC about office work analysis and I interviewed the manager of the computer center (my former boss) by telephone. We also discussed the problems of the current system with Korean students at NPS who have worked in ROKAIC.

As a result of this study of the existing system, a flowchart of the existing office services system was developed. This is shown in Figure 4.5 .

This flowchart represents the physical side of the existing system.

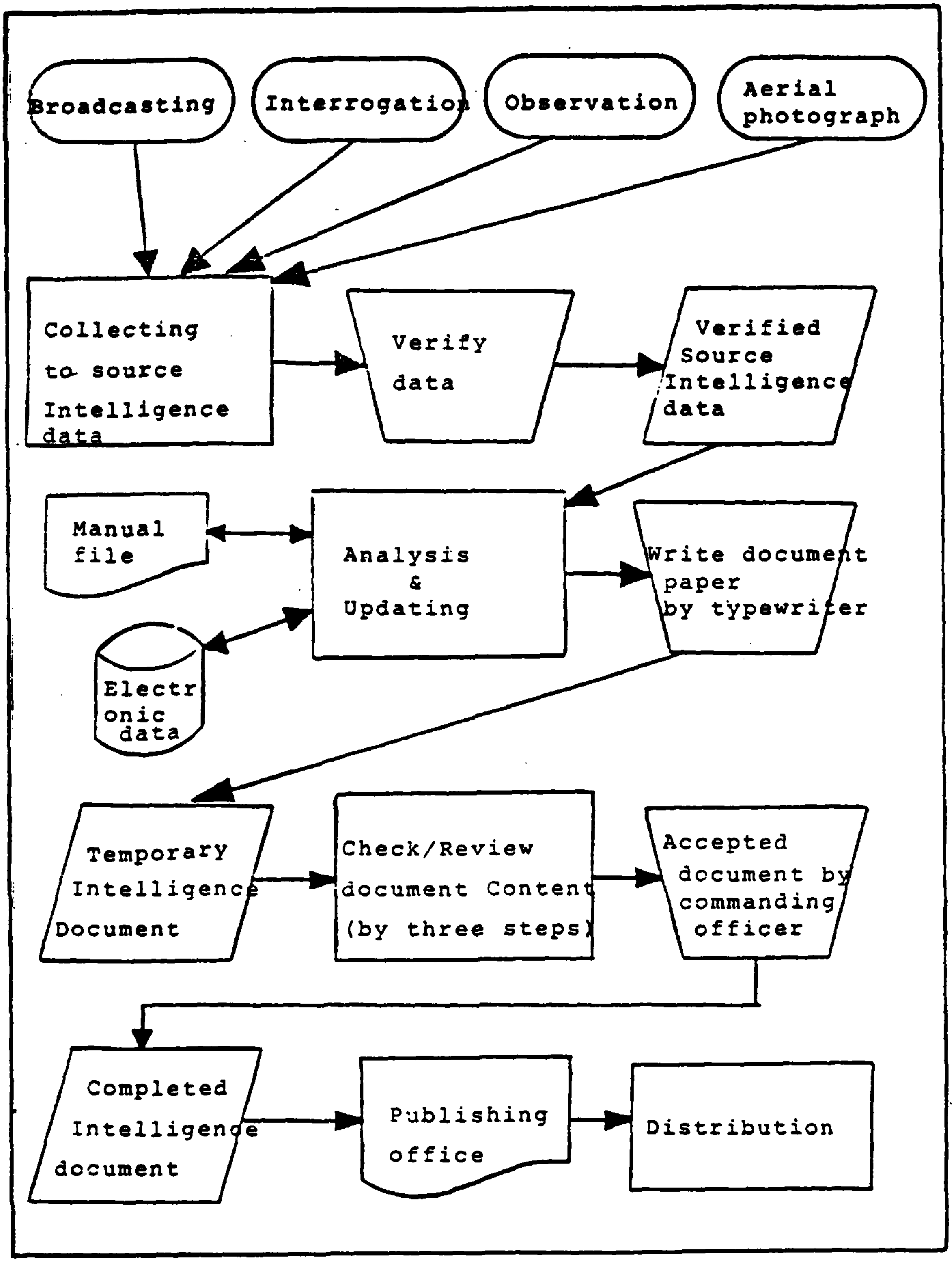

Figure 4.5 A system flowchart of the existing office services system.

A data flow diagram (DFD) of the current system is shown in Figure 4.6 . The DFD is a logical model of the existing system. Each element of DFD can be identified in the system flowchart of Figure 4.5 .

The source of data is the source intelligence data. The source intelligence data are provided by the various sources (broadcasting, interrogation, observation and aerial photograph, etc.).

The destinations of the data are the computer center, the management of each division, and the distribution outside the ROKAIC.

The processes represent the functions performed by the current system . First data is collected. Next the data is verified. The intelligence data is then processed (analysis/updating) and edited. Finally, compiled documents are distributed to each end user.

Data stores are the transactions, electronic data, manual files, senior officer's information (knowledge), and publishing works. Transactions are collected from intelligence data. Electronic data and manual files must always be maintained by office personnel. Senior officer's information and publishing works (office) are also data stores.

3. **Develop a high level DFD and function level DFD for the proposed system**

The most obvious problem with the existing system is the need for computer assisted retrieval (CAR) and word processing technologies to process documents. We can also make use of an electronic mail system by connecting the terminals from each office to the mainframe and thus reduce manual processes and complicated office services. As a result, we can achieve the computerization of overall office services.

The first step is to develop a logical model of the proposed system on the data flow diagram (DFD). It is best to start at the highest possible level as seen in Figure 4.7, showing the entire system as a single logical process and clearly identifying the sources and destinations of data.

The next step is to "explode" the process (document editing system) into its functional parts. In other words, that means replacing a high level process with its lower-level components as shown in Figure 4.8 . These two processes represent the basic functions that must be performed by the current system. They replace the document editing system in Figure 4.7 .

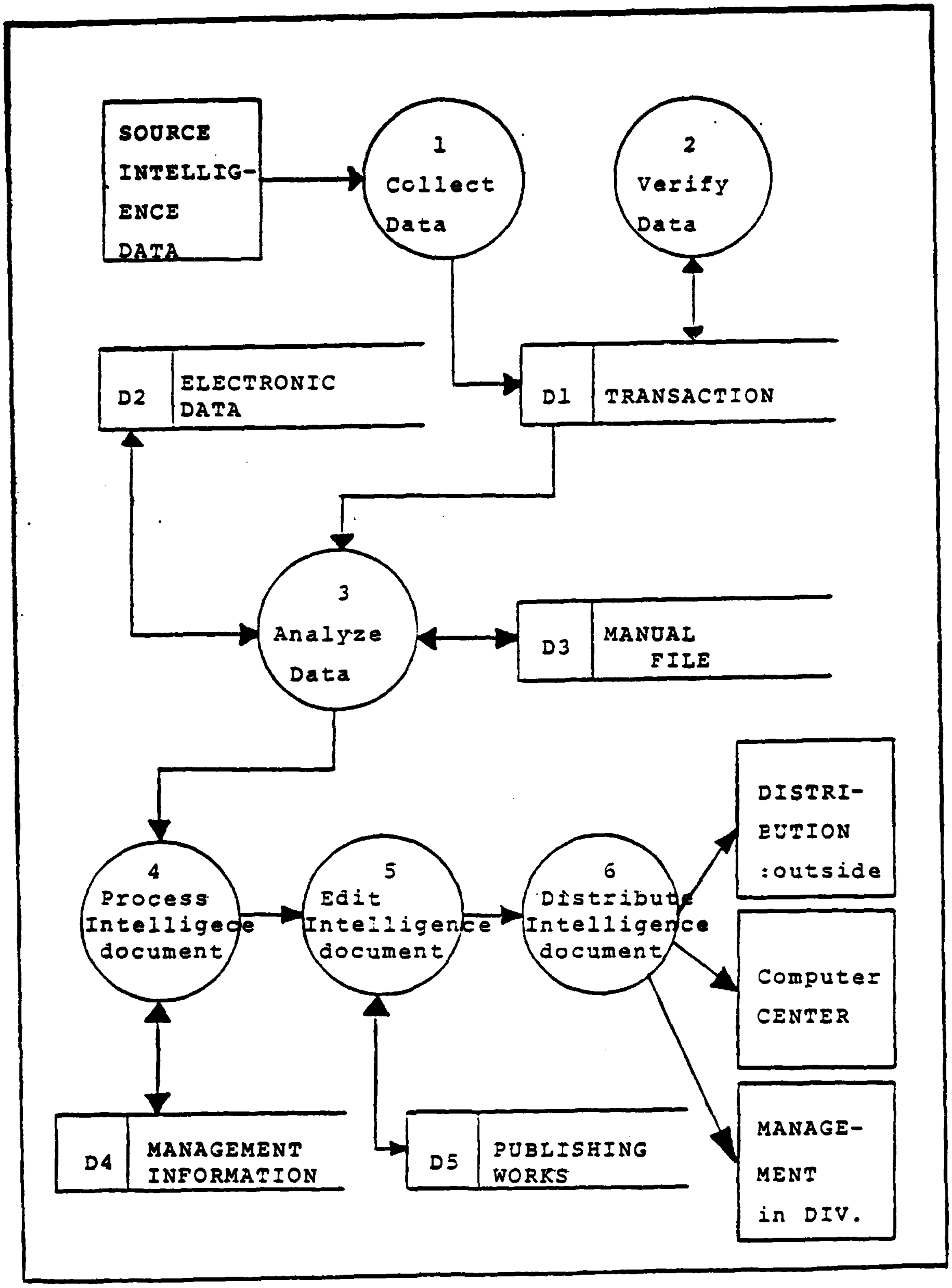

Figure 4.6 A data flow diagram of the current system.

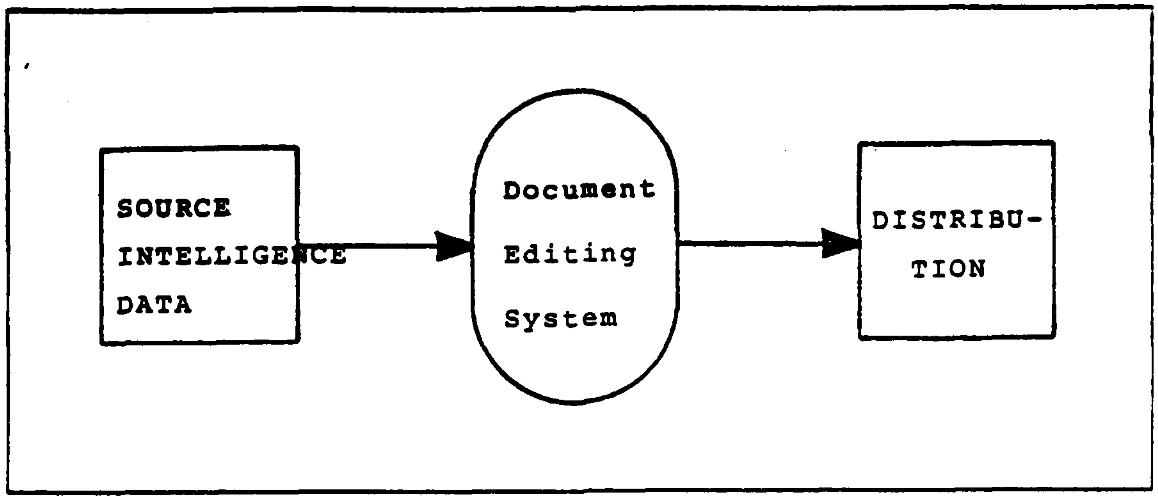

Figure 4.7 A high level DFD, highlighting data source and destination.

4. **Develop/Evaluate Alternative Solutions**

Given the model of the proposed system in Figure 4.8, we can begin to generate high-level, alternative physical solutions. We have to consider at least three different types of feasibility: *technical, economic, and operational.* The easiest approach is to start with technical feasibility as a driving mechanism with which the problem could be solved. According to Davis, we can consider three techniques to generate alternative technical feasibility solutions: (1) automation boundaries, (2) brainstorming, and (3) the checklist approach [Ref. 20: p. 276].

The automation boundaries approach will be used to develop alternative solutions. This begins with the data flow diagram. Using the time requirements of the various processes, it is possible to draw a number of different automation boundaries on a diagram, and each automation boundary might suggest a different physical system. In this section, we consider automation boundaries suggesting on-line document editing as shown in Figure 4.9 .

The source data are collected continuously: thus process 1, *process source data* must be on-line. Distribution delivers the daily information document once a day. Thus process 2, *generate intelligence document* would logically run in batch mode. We can also draw perfect automation boundaries on the a completed data flow diagram for the proposed system (see Figure 5.1) in the next chapter.

Operational or organizational feasibility is considered next, i.e. can the system be implemented in this organization ? We have to review the additional hardware and

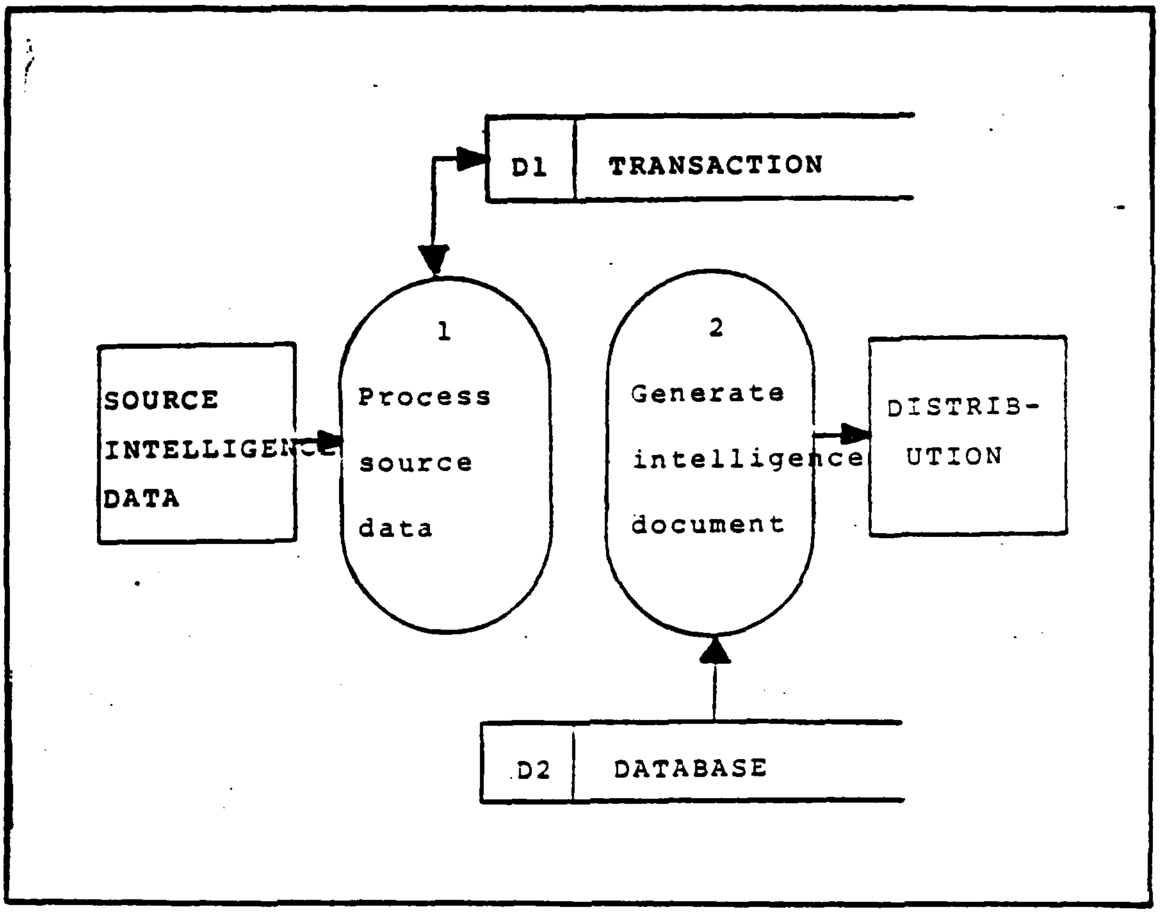

Figure 4.8 A functional level data flow diagram.

software needed to install an on-line document editing system, with potential suppliers for bid.

Finally, the economic feasibility estimates both the development and operating cost of each alternative. We can estimate expanding costs of a new system at roughly $10,000, with additional operating costs at $2,000/year and maintenance cost at $500/year based on current costs in Figure 4.10 . But we cannot perform a completed cost/benefit analysis because the computer center of the ROKAIC is not a *profit/benefit system.*

As mentioned in the previous section, ROKAIC is a very important agency for preventing North Korean aggression. The headquarters of the republic of Korea Army thus provides a substantial budget for ROKAIC.

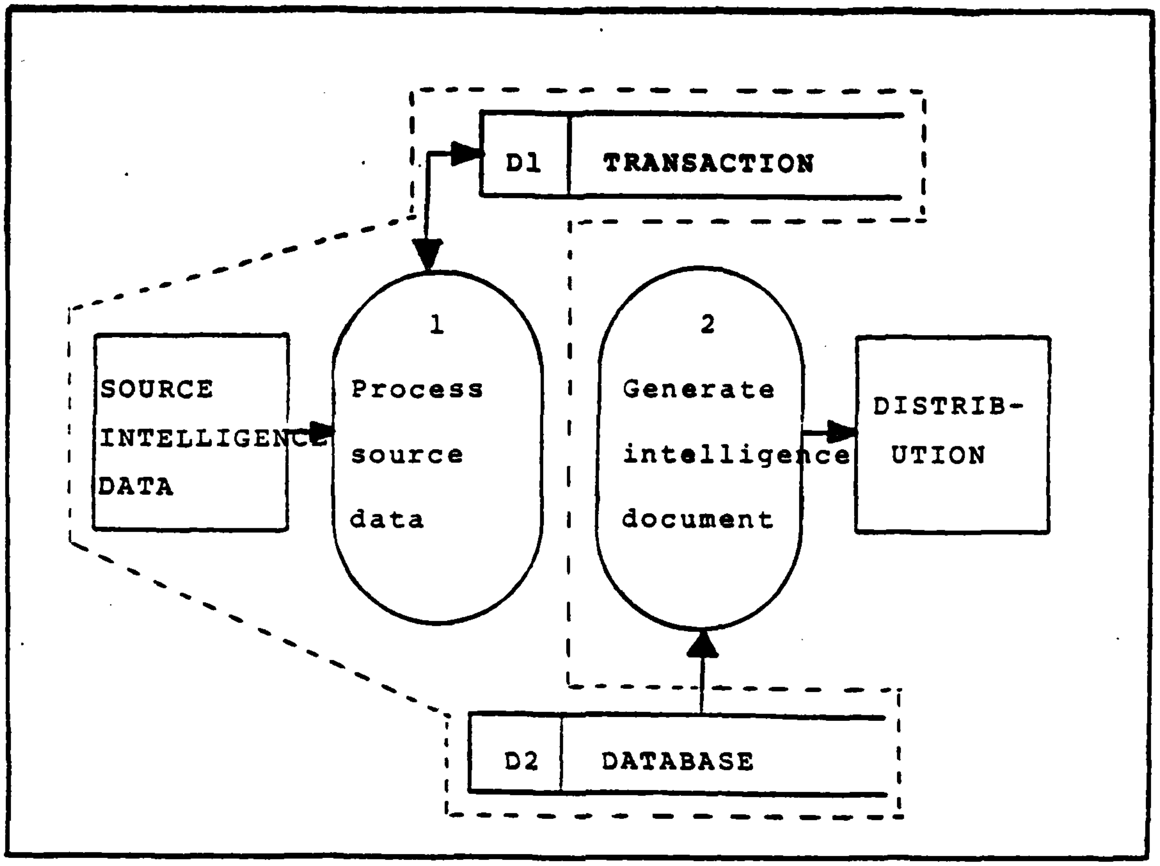

Figure 4.9 Automation boundaries an on-line document editing.

5. Recommended Course of Action

The logical model of the proposed system must meet the system objectives. We believe that the ROKAIC should expand the existing computer center to include the capability to perform on-line document editing procedures. During analysis, a set of functional specifications will be developed. During system design, general physical specifications will be written and sent to a number of potential suppliers for bid. The various alternatives will then be compared with the actual requirements of the current system during system design, and the best system will be selected. Finally, during implementation, the system will be ordered, installed, and tested, and office personnel will be trained. As mentioned in the first section of this chapter, current office personnel have never operated computer facilities. Consequently, all office personnel should receive basic computer training. They are estimated roughly 40-50 personnel including intelligence analysts and workstation personnel. The total cost should not exceed the $10,000 target, although it could go as high as $15,000.

1. Expanding costs:		
a. Microcomputer (purchase)		**$7,000**
b. Office control software		**$3,000**
c. Labor (current personnel)		
	TOTAL	$10,000
2. Operating costs - additional		
a. Supplies ($2,000/year)		$2,000
b. Maintenance		$500
	TOTAL	$2,500

Figure 4.10 A cost/benefit analysis of the proposed solution.

6. **Rough Out a Development Plan**

At this very early stage, it is difficult to estimate accurately the time, effort, and expense required to plan, design, and implement an on-line document editing system, but reasonable estimates based on the system life cycle are certainly possible. These are summarized in Figure 4.11 .

Steps	Personnel Time	Elapsed Time
Feasibility study	4/weeks	1.5/weeks
Analysis	6/weeks	2.0/weeks
Design	10/weeks	3.5/weeks
Implementation	8/weeks	3.0/weeks
TOTAL	28/weeks	10 /weeks

Figure 4.11 A rough implementation plan for the proposed cost solution.

The four-week feasibility study is included. During the analysis stage, we (analyst and computer center personnel) will be faced with the task of defining the functional requirements of the system. Among other things, we must learn a great deal about work flow and procedure of the main divisions. A month seems reasonable.

During system design stage, a set of broad, functional specifications for the new system will be developed. These specifications will prove essential in developing an on-line document editing system. The six-weeks (1.5 month) of full-time work seems appropriate. Using the functional specifications, we plan to investigate a number of integrated OA systems and OA software packages, and select the one that best meets current needs.

The final stage is implementation (maintenance is included in the continuing operating costs). Once an on-line document editing system is selected, it must ordered; some paperwork and a time delay of two weeks can be expected based on our country's situation. Before the new system can be accepted, it must, of course, be tested, so the document editing procedure will follow the existing system for the first month of operation. There will also be unanticipated delays, so the implementation stage is roughly estimated at 1.5 months of actual work spread over three months.

This simple implementation plan provides management with the answer to the following two questions: How long will the project take ? (six months), and How many people will be involved ? (probably 2-3).

7. Summary

A feasibility study is a compressed, capsule version of the entire system's analysis and design process. In the previous section, we began *structured system analysis and design* by clarifying the problem definition. In this section we first identified the objectives and scope - *what we are trying to accomplish* and *to provide a rough estimate of cost and schedule to accomplish objectives.*

We described the study results of the current system. And we produced the DFD of current and existing system. Then, we developed the automation boundaries on the functional DFD for the proposed system. Finally, we recommended a course of action and roughed out a development plan.

In the next chapter, we are going to do the analysis and design of the proposed system based on the feasibility study in this section. And we will produce a system flowchart and hardware specification of the proposed system.

V. PROPOSAL FOR AN INTEGRATED OA SYSTEM (IOAS)

A. GENERAL

In the previous chapter, the current information system used in the ROKAIC was described and problem definition and work flow pertaining to the system were discussed. A feasibility study for a proposed system was done and a functional level data flow diagram (Figure 4.8) was produced using the structured system analysis and design methodology.

The purpose of this chapter is to determine an appropriate model for improving office services using computer systems. This includes three steps: analysis, design, and implementation.

During the analysis stage, a complete DFD and data dictionary for the proposed office automation system is developed. These are based on "a functional level data flow diagram " from the feasibility study. As shown in Figure 5.1, the "data flow" on the DFD couldn't be described because "generated intelligence documents" include various kinds of service data. Consequently, a sample data dictionary (DD) by "simulated data dictionary" is shown.

During the design period, a physical system (system flowchart) is produced, one alternative automation boundary is selected, and hardware is determined. Based on structured system analysis and design methodology, a general system design is used rather than detail design. A set of specifications for each program is not considered a detail design because the purpose of this thesis is to propose "general system design methodology" and "a model" for implementing an efficient office automation. However, each component of the system (hardware specifications) required for the implementation stage is fully defined. in this stage, the flow is from the logical to the physical.

Finally, the implementation step, as the final step of the structured system analysis and design methodology is introduced. Implementation is simply the process of carrying out the approved recommendation. In this stage, it focuses on two major approaches, general strategy and principles for implementation rather than specific techniques.

B. ANALYSIS

1. Overview

In this section, the analysis step of the proposed system is considered. It begins with 'a functional level data flow diagram' from the feasibility study, develops a more precise data flow diagram (a logical model) and describes a sample DD as simulated data dictionary.

The objective of analysis is to develop a high-level, logical model of a system in greater detail.

2. Data flow Diagram (DFD)

In the previous chapter, a functional level data flow diagram of the proposed system was developed. See Figure 4.8. While its level was certainly appropriate to the feasibility study, the analysis step demands more detail. Each process of the functional DFD will be reviewed and exploded the processes of the DFD through functional decomposition. Essentially, one process on the diagram is selected and broken into its subfunctions. These lower-level functions then become processes on a new data flow diagram, complete with their own data stores and data flows.

We have to think about "the logical flow of data through the proposed system" and "what we think the system must do." First of all, consider the "process source data" function in the functional level data flow diagram of the proposed system of Figure 4.8 (see page 61). Logically, it might be reasonable to break this process into four steps as shown in Figure 5.1: (1) collect data, (2) verify data, (3) compile data, and (4) generate valued intelligence data.

First, the source data must be collected from the various resources. Simultaneously, they are input from end-users' terminals to electronic files. *Second*, collected data is verified by professional personnel by editing the electronic files. *Third*, verified data is updated by the professional intelligence analyst through electronic files and the database. *Finally*, updated data is used to generate "valued (summary) intelligence data" for inclusion in the "intelligence document."

Next, we consider the function of "generating intelligence documents." See Figure 4.8. It is relatively easy to visualize what the intelligence document generation process will do. In our situation, we can select a completed DFD for the proposed system by the first consideration function to do functional decomposition as shown in Figure 5.1 .

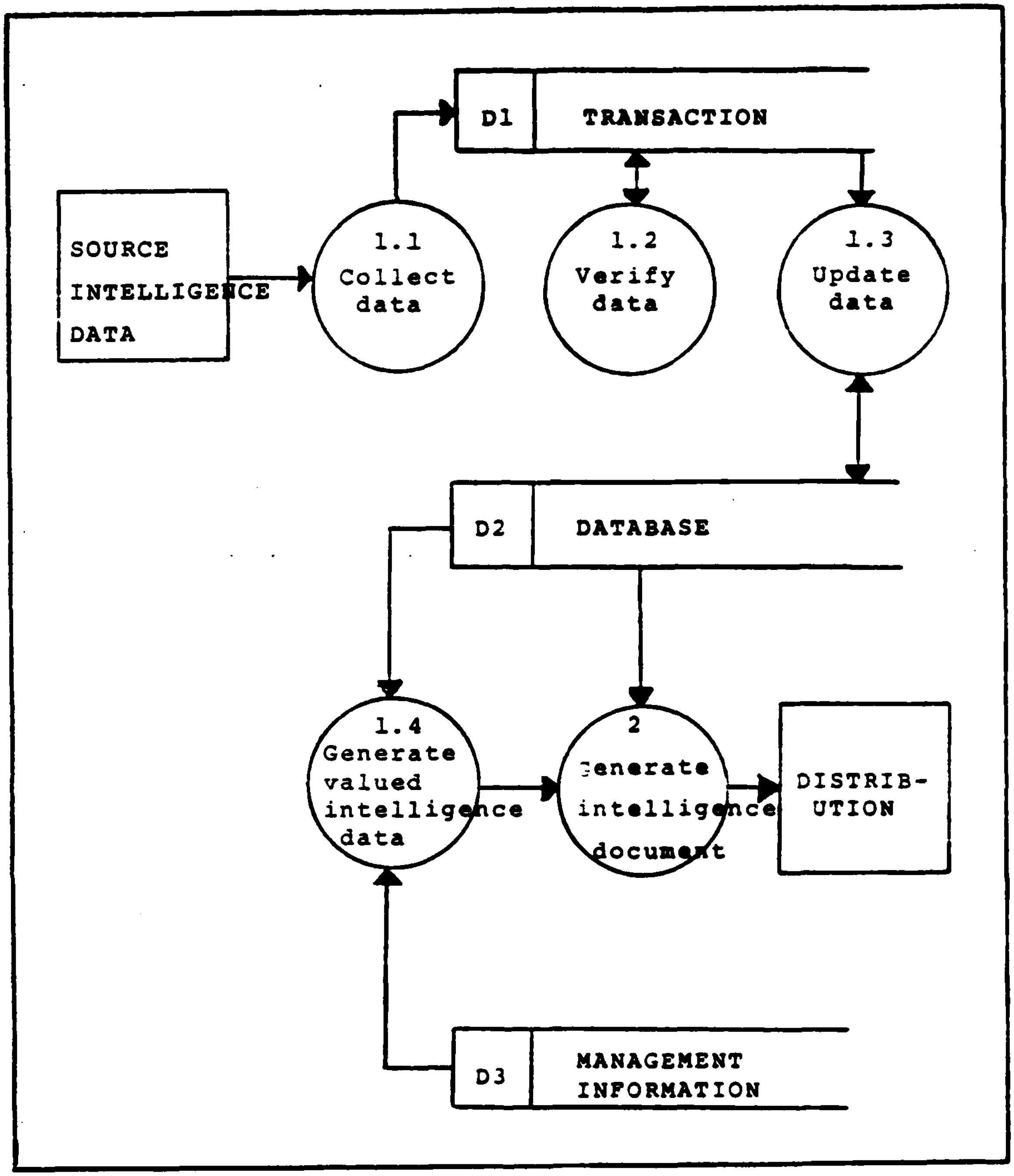

Figure 5.1 A completed data flow diagram for the proposed system.

After completing the DFD for the proposed system, we may have to check to see if the logical model meets the system objectives. In the next section, this logical model can be used in designing the new system.

3. Data Dictionary (DD)

A data dictionary is a collection of definitions of elements. The basic idea is to provide information on the definition, structure, and use of each data element an organization uses.

A data element **is a unit of data that can not be decomposed.** For each data element, such information as the element name, description, format, source, and use is recorded. The data dictionary helps the analyst organize information about data, and is an excellent tool for communicating with the user. Additionally, the data dictionary serves as a memory aid. Certain key information must be recorded for each data element. [Ref. 20: p. 202]

In the ROKAIC system, a complete data flow diagram for the proposed system is shown in Figure 5.1 . We cannot describe data flow on the DFD in more detail because each "generated information document" includes many kinds of service's data (order of battle, activities of North Korean military, political, military VIPs, and information on military arms of North Korea etc.).

A number of data dictionary software packages are commercially available. Some are associated with a specific data base management system. Others are more general. Many data dictionary systems are designed to generate source code for application programs. The analyst normally checks each data element against the data dictionary. If the element already exists, its name and format will be on the data dictionary, and generating the source code to describe that data element is a relatively simple task. If the data element is new, it can be added to the data base as part of the crosschecking process; once again, generating the source code should be easy. [Ref. 20: p. 297]

When we install the proposed OA system, we will consider the purchasing of a data dictionary software package. Therefore, we should not use real data dictionary software. But, a simulated data dictionary is introduced by Davis book. We will use this simulation throughout this thesis. To maintain a semblance of direct access, information related to each data element will be recorded on a separate 3x5 filing card and a minimum amount of information will be recorded for each data element as shown in Figure 5.2 .

It is good idea to establish a set of conventions for assigning data names. Often a given element of data will be known by more than one name thus any aliases or synonyms will be recorded. Next comes a brief *description* or definition of the data

```
Name: VISIT
Aliases: MEET, TALK
Description: Key word that identifies  the activity for
             VIP (political/military).
Format: Alphanumeric; 8 characters.
Location: VIP personnel file, DB
```

Figure 5.2 A simulated data dictionary.

element, followed by its type and *format*. Finally, information related to the physical *location* of the data element will be recorded.

An example of system services is illustrated by the following data collected by the N.B.S. broadcasting system of North Korea: "The President of North Korea, Il Sung Kim, went to the Soviet Union to meet the President of the U.S.S.R." We can at least lay out a skeleton data dictionary as shown in Figure 5.2 .

Continuous discussion with the user generates the data dictionary of the existing organization. We might also search the existing organizational data dictionary to see if a given element is used in another application; if it is, we can use the established information to describe the element. Missing information serves to alert us that work remains to be done. The data dictionary will eventually be completed, as a direct result of the systems analysis and design process.

C. DESIGN

1. Overview

Analysis is now complete, so we turn to system design. The objective is to produce an appropriate physical system design (system flowchart) within the context of a complete system and to determine how, specifically, the system should be implemented. At first, we develop an appropriate system flow chart of "on-line document editing" based on various automation boundaries then we recommend a physical implementation strategy. Next, the proposed system is designed using the Hierarchy Input Process Output (HIPO) technique. IPO charts are then prepared for

each module on the hierarchy chart. Finally, we describe hardware specifications, cost estimates, and, the preliminary test plan.

2. Generating alternatives / Selecting one alternative

The functional requirements of the proposed system are documented by the data flow diagram and data dictionary in the previous section. Now we have to generate feasible alternatives. At first, we imagine a number of automation boundaries on "a completed data flow diagram for the proposed system" of Figure 5.1, then we must devise a set of alternatives.

We can identify one or more reasonable alternative strategies from the resulting list of feasible options based on the initial statement of scope and objectives. An appropriate alternative will have functions with similar response time and there will be a logical relationship between the functions. In this case, as shown in Figure 5.1, we developed a very simple DFD of the proposed system. We thus can select one reasonable alternative strategy as shown in Figure 5.3 based on the timing requirement.

The source data are collected continuously, thus process 1.1 *collect data*, must be on-line. And this encloses process 1.2, 1.3, and 1.4 within a common boundary. Now our system would accept *collect data, verify data, update data, and generate valued intelligence data.* At the destination end of the DFD, distribution delivers the "daily intelligence document" once a day. thus process 2, *generate the intelligence document*, would logically run in batch mode. It is shown in Figure 5.3 . The processes included within the automation boundary could all be performed by a single program.

3. Recommend an appropriate alternative

As a selected alternative to Figure 5.3, several microcomputer systems have to be installed in each end-user desk and professional analyst desk to collect and verify the data by using on-line computer terminals. And additional new programs will be needed to maintain the on-line system. We also have to consider a system flowchart of one alternative system design as shown in Figure 5.4 .

A system flowchart is a traditional tool for describing a physical system. A logical model for the proposed system is constructed using the data flow diagram in the previous section. In this section, the logical model must be converted to physical form using a system flowchart. The basic idea of the system flowchart is to provide a symbol to represent, at a black box level, each discrete component in the system: programs, files, forms, procedures, and so on.

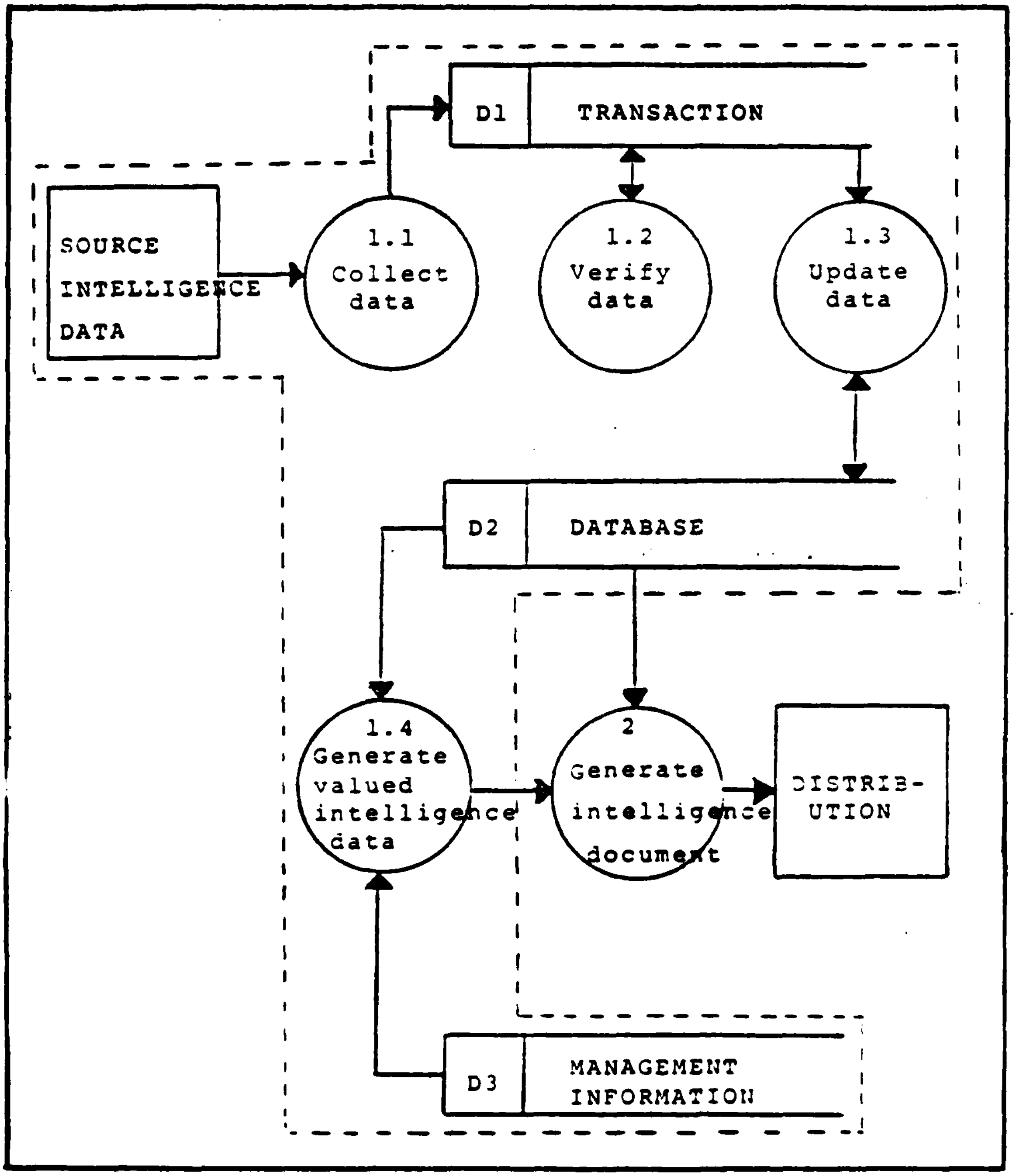

Figure 5.3 One alternative automation boundary.

We can construct the system flowchart for the proposed system as shown in Figure 5.4 . The system flowchart (Figure 5.4) identifies three additional programs, five files, five microcomputer systems, and six numbers of CRTs. To describe, in detail, the

planning for each component would require hundreds of pages, consequently we do not consider more detail in this thesis.

As shown in Figure 5.4, the existing system suggests a design that consists of three additional kinds of programs: an on-line program, office management program, and system control. The system control program contains all the immediate functions, i.e., all functions that must be performed interactively with a user terminal in each office.

Figure 5.5 lists the physical elements (programs, manual procedures, files, and forms) that will compose the proposed system. After these components are implemented, we can begin to plan our implementation and time/cost estimates. Now time and cost estimates can be based on concrete physical components, rather than on imaginary functions. The cost/benefit analysis for the proposed system is estimated with a major decision: make or buy as shown in Figure 5.6.

Next, we consider the implementation schedule for the proposed system. Although we can estimate writing a system (option B) based on manpower status for the current system, option A is simply no way to control the schedules of people who work for other organizations. We have two high-level analysts and three excellent programmers who have worked as programmer in our system for seven years. We estimate an implementation schedule of three months using two analysts and two programmers.

From the above results, we feel that the proposed system should be implemented, an on-line document editing system. The data collection microcomputer is interesting, but the extra $3,000 investment violates the system's intended scope. We are sure that the proposed system should write rather than purchase the software, because we can reduce by over $3,000 the estimated cost/benefit analysis for both options presented in Figure 5.6 . Furthermore, the cost and time estimates associated with option B seem more dependable. We consequently recommend option B (Make) to the commanding officer for installing the proposed system and only specify the new devices of the proposed system based on the previous alternative as shown in Figure 5.7 . We consider new devices comparable to current system devices.

4. Hierarchy Input Process Output (HIPO)

We have created "a system flowchart of one alternative system design" in previous Figure 5.4, which identifies several programs. Now, we will develop a set of specifications for those programs using hierarchy plus input process output (HIPO) technique.

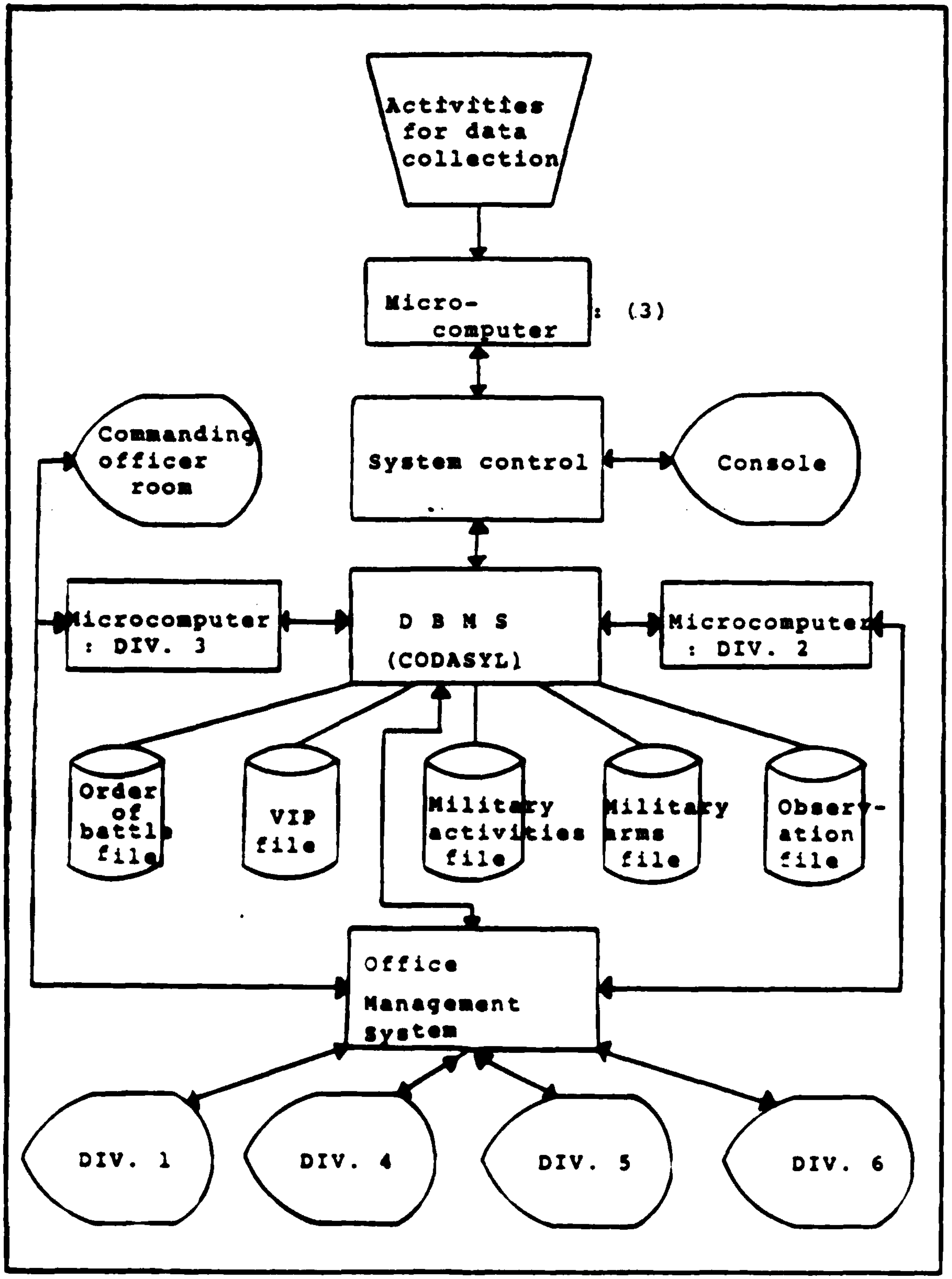

Figure 5.4 A system flowchart of one alternative system design.

1. Programs (new): a. On - line b. System control c. Office management	**2. Microcomputer: (5)** a. Division 2 b. DIV. 3 c. End-users (3) : data input
3. **Files:** (5) a. Order of battle b. VIP c. Military activity d. Military arms e. Observation	4. CRT terminal: (5) a. Division 1 b. DIV. 4 c. DIV. 5 d. DIV. 6 e. Commanding office
5. **Software:** a. DBMS b. Office management S/W	6. **Manual procedures:** a. Activities for the data collection

Figure 5.5 The physical elements of the proposed system.

A hierarchy chart is used to represent the top down structure of the program and expand hierarchy chart via functional decomposition module level. As a basic rule, the most important guideline is probably common sense. If decomposition makes the logic easier to follow; decompose. We produce a completed hierarchy chart for the proposed system as shown in Figure 5.8 .

Start at the top with on-line document editing system. First, *Initialize* is invoked; it, in turn, invokes fill tables and sends control back to 'on-line document editing system'. Next, 'process source data' is invoked. It calls or invokes collect data and so on. As a result, the three modules controlled by process source data are executed, and control is returned to 'generate valued intelligence data'. Each module on the hierarchy chart is described in detail on a single IPO chart.

An Input/Process/Output (IPO) chart is used to describe the inputs to, the outputs from, and the process performed by the module and it is prepared for each module on the hierarchy chart. The format of an IPO chart and an example, process source data' is shown in Figure 5.9.

An IPO chart shows the inputs to, outputs from, and process performed by a routine. For an example, consider 'process source data'. The top blocks show how the

1. Development Costs

A. Prior estimate (from feasibility study) $10,000

B. New estimate (system design phase)

1) Option A: Purchase all software

a. Already spent (labor)	$2,000
b. System design	1,000
c. Implementation/training	2,000
d. Purchase price - software	4,000
	$9,000

2) Option B: Write original software

a. Already spent (labor)	$2,000
b. System design	1,500
c. Implementation	3,000

2. Operating Costs (annual)

	Option A	Option B
Labor:	$1,250	$1,250
Maintenance:	500	250
TOTAL	$1,750	$1,500

3. Cost saving and Return on Investment

	Existing	Option A	Option B
Operating cost	8,000	1,750	1,500
Cost saving	-----	3,250	3,500
Investment	-----	9,000	10,250
Return on investment	--	23% +	26% +

Figure 5.6 A cost/benefit analysis for the proposed system.

module fits into the program hierarchy. 'Process source data' is called or invoked by a higher level module, 'on-line document editing system'. It calls four lower level modules: 1) collect data, 2) verify data, 3) Update data, and 4) generate valued intelligence data. Next come the inputs and outputs. The data dictionary is the source of the inputs and outputs, and the algorithm descriptions define the processes.

1. Microcomputer systems: Sam-Bo Trigem personal computer sets with printers

2. CRT terminal: Same devices as current system by Prime computer co.

3. Additional hard disk: Same devices as existing

Figure 5.7 A hardware specification for new devices.

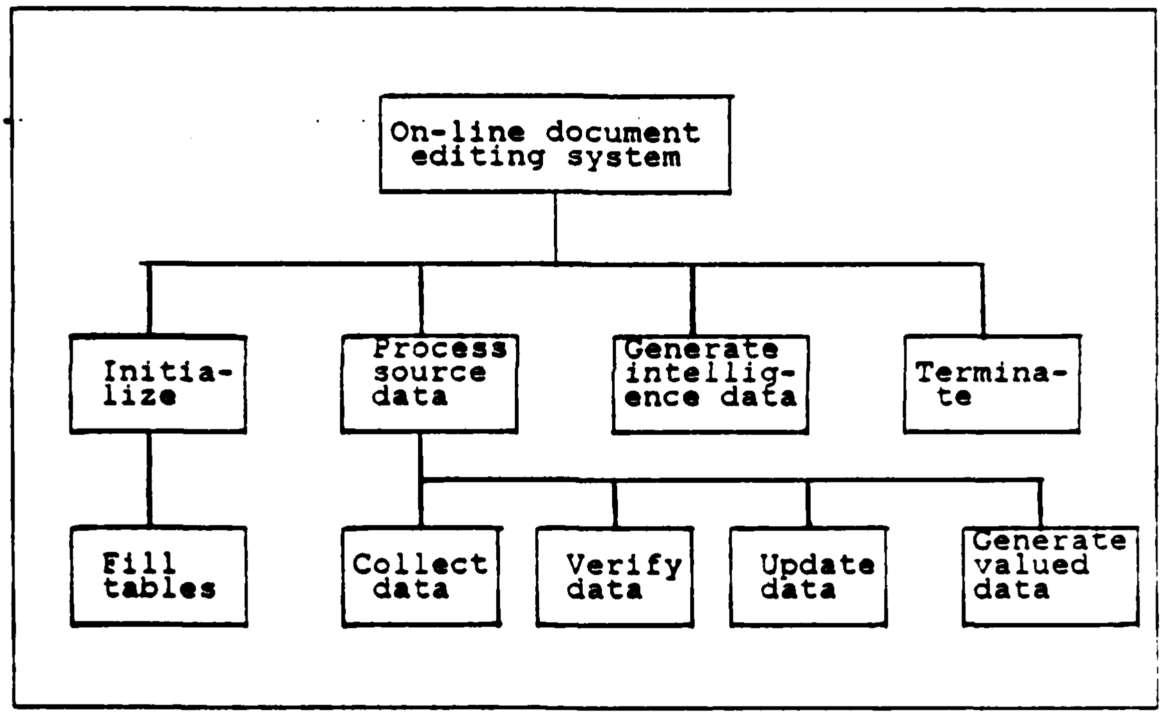

Figure 5.8 A completed hierarchy chart for the proposed system.

D. IMPLEMENTATION

1. General

The structured system analysis and design for the proposed OA system have been discussed in the previous section. We are going to discuss the implementation step, as the final step of the structured system analysis and design methodology.

SYSTEM: On-line document editing system

PREPARED BY : JOO

MODULE: Process source data

DATE: Feb. /87

CALLED OR INVOKED BY:

On-line document edit system

CALLS OR INVOKES:

1. Collect data
2. Verify data
3. Update data
4. Generate valued data

INPUTS:

Outputs:

PROCESS:

LOCAL DATA ELEMENTS:

NOTES:

Figure 5.9 An IPO chart in example.

Implementation is simply the process of carrying out the approved recommendation. It is concerned with coding, documenting, and debugging the programs. The need for training is an often overlooked aspect of system implementation. We have to consider that a computer system already exists, we are simply expanding the current system. We only need user training for the microcomputer and CRT terminal.

In this section, we focus on two major approaches, general strategy and principles for implementation rather than specific techniques.

2. Major approach for implementation of office automation

There are two major approaches to the implementation of office automation. *One* is the interim or short-term approach, referred to as transitional or pilot implementation. *The other* is the long-range strategy that implements extensive electronic integration, referred to as office automation. The primary difference between the transitional and the automated office process lies in the interconnection of the various electronic and technological components. A transitional approach at a latter time can phase into a network of information for the integrated electronic phase. A transitional approach is similar to pilot implementation. Pilot implementation of office systems provides a low risk approach to OA and, at times, serves to break the ice when introducing a new technology. For this purpose it is the recommended strategy which will be employed in this section.

Implementation for office automation is analogous to construction in the building trades where the tools (computer technology and methods) are applied to materials (knowledge/information) to construct a building (application) based upon architecture (strategy). Next we describe the general rules for the implementation strategy.

3. Steps of the Implementation Strategy

a. Assign the Facilitator

One of the first steps to be addressed is the appointment of a senior level officer responsible for OA. In many cases, the facilitator is the technologically sophisticated person assessing the availability of innovations for his system and reporting to management. The facilitator is the resident expert, planner and 'pusher', analogous to the architect in the building trades. This role has been found to be critical to the success of the implementation. The facilitator must control the flow of information and technology into the using organization, preventing user overload. In the ROKAIC system case, the computer center manager and information division manager can be considered co-facilitators.

b. Determine Organizational Readiness

The first step is the most crucial: to determine that the organization is ready to make the commitment and changes required by automation. Commitment must be from an inhouse office automation team including the facilitator and top

management. The organization's team must have the necessary resources, including assistance from consultants who have had direct experience with office automation. Important factors are a willingness to start small and increase the user population over a period of years, an interest in gaining experience, a commitment to evolution rather than to a fixed system, and an understanding that technical and management problems will arise. The team should include the computer center manager, the manager of user departments, and vice-president of the ROKAIC system. This group could be structured on either an ad-hoc basic or as a permanent unit which would oversee and continue to monitor all of the office automation efforts of the organization. Drawing members from these varying departments serves a two-fold purpose. It provides first-hand knowledge of what goes on in those departments, and it creates a feedback mechanism which keeps those departments advised of the OA impact in their area. Meeting and seminars are necessary to create awareness of the potential problems and educate all potential users and management about office automation.

c. Select the Core User Group

Once a commitment to automation has been made and the facilitator selected, a group is identified in cooperation with the facilitator that will serve as the core group for the initial application. The group must be able to follow the implementation principles (see next section). Most importantly, group members must be motivated to explore alternative ways of working, and be willing to innovate without feeling threatened personally or professionally. Selection of this core set of users is vital to the success of the strategy: they must be visible or have high potential for becoming visible to the rest of the organization, sympathetically managed, and adept at using new technology.

d. Assessing the OA requirement

Selection of the initial automation application requires considerations not necessary with subsequent applications. A visible, immediate product that does not require complex procedures or extensive skill at using the system is crucial. Less tangible applications such as calendars or shared data bases may not be as effective as messages or document production. Participation of the core user group in the selection of the application generates feelings of involvement and motivation, and assists understanding of the application environment.

Typically, the assessment begins with four types of measurements: discussion with department manager, discussion with core user groups, observation of office activities, and secondary sources.

(1) *Discussion with department manager.* This is necessary to obtain an initial view of the organization's objectives, current system, and current system plans. In addition, the department manager should be briefed on key aspects of OA and the methodology of the assessment. Prior to the interview the department manager should be provided a pre-interview memorandum describing the nature of the interview and what is expected on his part. The national bureau of standards (NBS) has published sample worksheets that provide guidance in conducting such an interview (see Appendix D). [Ref. 22: p. 19]

(2) *Discussion with core user group.* The purpose of this interview is to determine information flow, time requirements, office methods, and, among other things, training requirements. It is an effort to break down into measurable terms what the employee does to support the organization's mission. These interviews should be conducted with a representative sample of the organization work force. Appendix E contains NBS guidance questionnaires for this purpose (see Appendix E). [Ref. 22: p. 45]

(3) *Observation of Office Activities.* Additional data may be obtained through monitoring office activities. This part of the study involves measuring the time it takes individuals to perform certain tasks, whether typing or nontyping. Through the observation of work activities, demands and bottlenecks in current practices will be identified. [Ref. 9: p. 551]

(4) *Secondary Sources.* Documents such as the current system manual, SOP, secretarial daily time sheet, and procedure guidelines provide the team a comprehensive overview of the current system in a short period of time.

e. Conversion

Conversion to a new support system is generally a phased-in process even when it is a pilot or prototype installation. It consists of installing new equipment and converting the work from old to new equipment, changing to new procedures, relocating personnel to new or different workstations, and communicating these moves on a daily basis. Careful planning and open communications can prevent complications and make the conversion a less disruptive experience.

We will set up a test situation of the type of installation being considered for wider use in the system. Some advocates of prototypes believe they can take the place of the traditional feasibility study. However, volumes of data and machine performance are needed to provide a basis for a before and after comparison. Next, we consider the general implementation principles. [Ref. 9: pp. 357-358]

4. Implementation Principles

Principles have been developed from James H. Bair's research (1974) that, if followed, can make the difference between a success or a costly fiasco. They place an emphasis on environmental, social and psychological factors. Although there have been serendipitous successes, the principles are necessary to guide a smooth transition to new working methods, minimizing the probability of system failure.

a. An Adequate Level of Usage Must be Maintained

The realization of the full potential of office automation is dependent upon more extensive use of online time. With the exception of programming applications, online time is relatively low in traditional computer applications. In some cases, this requirement results from the nature of the application.

The cost of system usage can be a deterrent to maintaining an adequate usage level. The charging algorithm for computer service should not be based on usage time (online time). Service should be provided based on a periods of time (months or quarters) so that cost is not a deterrent to increasing the amount of use.

b. The Environment must be Flexible and Workstation Oriented

Special attention must be given to the appearance, acoustics, furnishings, flexibility, and overall warmth of the environment in which individuals will use the computer technology for most of the workday. The group should have facilities which promote the incorporation of new technology and procedures into their offices. The 'open office' is one approach to the allocation of space for equipment, with the provision of necessary power, lighting, sound absorption, and communication lines. However, the office landscape will more effectively support the system if there is visual and audio privacy. This may require private offices that are "wired" with high speed data links. One approach to the office environment has been specified by Herman Miller Research Corporation.

c. Equipment Must be Available to Each User at All Times.

Experience has reinforced the principle that equipment should be available to each individual participant at all times during his working day. Detailed descriptions of the problems and effects of equipment nonavailability have been discussed in the literature. Although hardware availability is often considered secondary to training and other implementation factors, it is vital to success. Systems typically include a display workstation, a teletypewriter, a high-speed printer, and optionally a high quality, medium-speed printer. Terminals should be provided to

users within easy reach of their offices or, preferably within each individual office. It is consistent with the level-of-usage-principle that each person have his own terminal and immediate access to printing facilities.

d. Co-Workers Must be system Users

The system must serve all the people who work with information in the organizational units being automated, regardless of their formal role. The implementation should ultimately include all knowledge workers in the organization. This is important for morale and motivation. It is difficult to resist using a system that is used by all the individual's peers.

e. There Must be a Need to Communicate within the User Groups.

The user population should form a community which is defined by a communication network resulting from common ground among the members. Common goals, tasks, management, and interests generate communication traffic. The absence of an explicit need to communicate renders it rather meaningless to use office automation systems that place emphasis upon interpersonal communication. Studies have supported the notion that the absence of a need to communicate can result in a rejection of the new system, regardless of the other services available.

f. An Ongoing Assessment is Desirable

Ongoing assessment for at least the first two years of operation will provide management with feedback about the implementation performance, permitting corrective action if performance is suboptimal. Implementation without a formal assessment is analogous to trying to navigate a mine field blindfolded. Assessment at the organizational level provides data about changes in productivity, turnaround time, communication patterns, employee morale, responsiveness to customers, and the time consumed in adjusting to and operating the office automation technology. Changes may be caused by factors other than the office automation system itself.

g. Adequate User Support Must be Provided

Each user requires support, not only in the form of training, but in the form of specialized documentation, a channel for feedback, and ongoing consulting in the use of the technology. When any of these support elements are missing, the office automation system has a much higher probability of being rejected or being used ineffectively. The next section describes each of the elements of user support.

5. Conclusion

Practical implementation requires a management commitment to restructuring and a philosophical decision to change through division of work, work specialization, and crossing of departmental lines. The implementation process itself deals with carrying out all of the steps previously described in this chapter.

The important considerations are the following:

1) Reporting relationships
2) Restricted and revised job descriptions
3) Human engineering and personnel fit of the proper person and the proper job.
4) Communication leadership and training
5) Designing the space to fit the needs of the new structure
6) Preparing the procedures

The implementation process should be flexible, dynamic, and easily modifiable. Implementation is usually a complex activity that requires careful planning, control, and coordination of all resources in the planning process.

E. SUMMARY

In this chapter, a completed data flow diagram was developed for the proposed system in the analysis stage based on a functional level DFD developed in the previous chapter. A data dictionary was considered using a simple example based on 'a simulated data dictionary' because we could not define data flow in this thesis.

Next, we considered an 'automation boundary approach' on the DFD to generate an appropriate alternative based on timing requirements. As a result, the recommended system flowchart for the proposed system was constructed in Figure 5.4. I reviewed the cost/benefit analysis for the proposed system and recommended option B (to write original software).

Since the ROKAIC already has a computer system, I only considered expanding the existing system to accomplish "on-line document editing and integrated office automation." Thus, we did not consider specific procedures for implementation. I also introduced a general strategy and principles for implementation. In the next chapter, I recommend the installation of an expanded office automation system for the ROKAIC.

VI. CONCLUSION

A. GENERAL

This thesis has provided both an introduction to office automation and a strategy (analysis and design) for implementation using the structured system analysis and design methodology. We showed that the computer center of the ROKAIC needs to install an integrated office automation system to meet the specific needs of the user community and to provide more efficient performance in computer system. An integrated office automation (IOAS) present users, information managers, and top level decision makers with a great deal of flexibility and diversity of choices for office productivity and design in the future.

The field of office automation will undoubtedly change over time as planners and developers create newer and better systems. To implement a successful IOAS it is necessary to establish control over the office technologies as well as meet the challenge of successfully adapting people to the new environment, policies, procedures, and equipment.

The first three chapters introduced the tools and methodologies of traditional office automation. Chapter IV described the mission, organization, and present computer system of the ROKAIC, as well as the feasibility study. study. Chapter V discussed the system analysis and design for an integrated OA system, describe the implementation strategy, and provided a recommended system flowchart which would implement an Integrated OA in the ROKAIC.

B. RECOMMENDATION

The integrated OA system can only be measured in terms of its impact on organizational performance. The purpose of such systems is to help improve the performance of office personnel and, collectively, the performance of the units to which the individuals are organizationally assigned. The information center or the integrated OA system is a facility. It cannot be successful in and of itself, even if it is composed of good-equipment. It needs the support of top management, not only in terms of budget, but also in terms of its integration and implementation. To implement a successful integrated OA system in the ROKAIC, I strongly recommend the following basic elements:

- Adopting a suitable implementation strategy and new challenges.

- **Positive commitment of the top management (commander) is necessary as well as the support of an ample budget.**
- **Participation with user groups and overcoming user resistance to change**
- **Training to cultivate high manpower**

Finally, co-ordination between the user community and computer personnel is the most effective way to succeed in implementing integrated office automation.

APPENDIX A
ETHICS METHODOLOGY

1. ESSENTIAL SYSTEMS ANALYSIS

a. Identify problem or opportunity

In this step, the question 'why are we changing?' is posed. The purpose is to identify the particular opportunities available by a new system or a problem which needs attention.

b. Identify system boundaries

Users are asked to identify those departments and units of the organization and its environment which are likely to be directly affected by the proposed change. Mumford suggests four areas for consideration:

1) Business activities affected, e.g. sales, finance, and personnel,
2) Existing technology affected, e.g. computer systems and office systems,
3) Parts of the corporation affected, e.g. departments and sections, and
4) Parts of the corporation's environment affected, e.g. suppliers and customers.

c. Description of existing system

This is undertaken to help ensure that the design team understands how the existing system works. It is concerned with defining what happens now. There are two approaches to providing such a description: 1) Simple input-output analysis, where the principle inputs and outputs are identified and analyzed, and 2) Activity analysis, where the system needs and activities are identified under five headings: a) Operational activities, b) Problem avoidance/correction activities, c) Coordination activities, d) Development activities, and e) Control activities.

d. Identify key objectives and tasks

The purpose of these stages is to identify the key objectives and tasks which the new system must support. It starts by eliciting the key objectives of the department, section, or functional area which is the focus of study, describing why these objectives exist and how close they are to being met. Next, the tasks which must be carried out if the objectives to be achieved are identified. Mumford suggests that these should be specified in broad terms, without going into too much detail.

e. **Identify unit operations**

Related sets of tasks that can be integrated into what Mumford calls 'unit operations' are noted. These are subsystems associated with each objective identified in step 4.

f. **Identify key information needs**

The key information required if each key task is to be successfully completed is set out. This could be carried out through input-output analysis where the principal requests for information coming from outside and the information collected by departments within the system boundaries are noted, as well as where the information processed in the system is passed on to.

g. **Diagnose efficiency needs**

Efficiency needs are identified by looking for examples of variances in the system which is being redesigned. According to Mumford, a variance is a tendency for a system to deviate from some desired norm or standard. Variances caused by a shortage of information are particularly noted. The areas where discrepancies are likely to be identified are: variances due to inadequate resources; variances due to errors which originate outside the system boundary; and variances due to the complex nature of external demands.

h. **Diagnose job satisfaction needs**

Job satisfaction is defined by Mumford as the 'fit' between what people would ideally like to have as a work situation and what they perceive they are receiving. Needs arise from a 'bad fit' between the present and the ideal, and must be corrected in the new system. Job satisfaction is seen to be achieved when three types of needs are met in the work situation; personality needs, competence and efficiency needs, and associated with personal values.

i. **Forecasts future needs**

Because the environment changes so rapidly, most work systems have only limited lives. To prolong their lives for as long as possible, it is necessary to be able to adapt to change. Thus, those factors in the environment which are likely to change, and to which the new system must adapt, need to be identified.

j. **Set and rank efficiency and job satisfaction needs**

All groups with an interest in the system should take part in this exercise. The users are given a list of objectives and invited to rank each one on a scale of 1-5. The suggested occupational groups who would be involved in the ranking are data-

processing staff, and user managers and staff from the relevant user departments. Each group would rank the objectives according to their own preferences.

2. SOCIOTECHNICAL SYSTEMS DESIGN

a. Identify technical and business constraints

In this stage, the technical and organizational constraints on the design of the system are set out. Examples of these constraints are security, back-up and recovery, and availability of hardware.

b. Identify social constraints

Here, the social constraints on the design of the system are outlined. An example of a social constraint is the desire to reduce the overall number of staff but without forced redundancies. This is the human counterpart to the technical constraints identified in step 12.

c. Identify resources available for the technical system

This step sets out the resources available for the technical system Examples of these resources are availability of personnel, equipment, and finance.

d. Identify resources available for the social system

Similar to the previous step, it identifies those resources which can be used for the social system. Availability of personnel, training, consultant, finance, etc., are all examples of such resources.

e. Specify the priority of the technical and business

Objectives From the list of objectives outlined in step 11, the different occupational groups are expected to reach a consensus on a priority list for the objectives. Only technical objectives which are feasible, given the cited constraints, should be considered.

f. Specify the priority of the social objectives

Again, similar to step 16, it is the social objectives which are addressed.

g. Check for compatibility

In this step, the objectives discussed in the previous two steps are checked to ensure they are compatible. If not, the objectives have to be revised in light of the incompatibility. As the result needs to be agreed by the various occupational groups, it is possible that the process may be iterative.

h. **Take technical system decisions**

For the technical system, a variety of decisions will need to be taken-decisions about input, the computer, output, and the like. Input questions relate to how the input would be handled, what equipment to use, and so on. Computer decisions relate to what the machine will do, what it will not do, and what will be handled manually. Output decisions are concerned with output, media, format, frequency, and the like.

i. **Take social system decision**

For the social system, the human counterpart to the above decisions are considered. For example, choices about input jobs (e.g. how to organize jobs associated with the input of data to the system) and output jobs (how to organize jobs which are both connected and unconnected to the computer, and how to integrate them) are discussed.

3. SETTING OUT ALTERNATIVE SOLUTIONS

a. **Set out alternative technical solutions**

In this step, a maximum of four or five different technical solutions are outlined, each of which is compatible to the stated objectives. For each alternative solution, both the technical and social advantages and disadvantages are set out in a matrix, which facilitates comparison. Each technical solution is evaluated against the following criteria: (a) Does the solution achieve all the priority technical and business objectives which were specified in step 16? Does it achieve all or some of the non-priority items? (b) Is the solution limited in any way by the constraints identified in steps 12 and 13? (c) Are the various resources identified in steps 14 and 15 adequate to realizing the solution?

b. **Set out alternative social solutions**

In step 11, a comparison between the social desires and the perceived reality was carried out on five needs: knowledge, psychological, support/control, task, and ethical. Those areas of poor 'fit' would be the central focus of the alternative social solutions. When setting out the alternative social solutions, it is important to consider them independently of the technical solutions at this step.

4. SETTING OUT COMPATIBLE SOLUTIONS

a. **Set out compatible sociotechnical solutions**

In this stage, the short lists of technical and social solutions are merged to see which pairs of solutions are compatible with one another. Those which are

incompatible are discarded. When a technical and social solution is found to be able to operate together, the combination is entered into an evaluation matrix which is used in the next stage.

5. RANKING SOCIOTECHNICAL SOLUTIONS

a. Rank the matched solutions

The compatible pairs of technical and social solutions entered in the evaluation matrix in the previous stage are now ranked using the information generated in steps 21 and 22. It is important that the proposed sociotechnical solution still meets the criteria outlined in stages 1 and 2, namely: (a) Does the chosen solution meet both technical and social needs? (b) Are sufficient resources available to achieve both the technical and social diversions of the solution? (c) Are there any constraints which make the solution infeasible? (d) Does it meet other technical and social objectives set out in step 11 but did not become priority objectives?

6. PREPARE A DETAILED WORK DESIGN

a. Prepare a detailed work design for the sociotechnical solution

In this step, a list and description of all the taskes which people will perform if the particular sociotechnical solution is implemented is developed. These taskes are ranked in terms of simplicity and checked to see if there is any way of combining or arranging them into jobs to provide a balanced spread of required skills and complexity of tasks. The arrangement of tasks needs to be checked to make sure the created jobs are as interesting and satisfying as possible. Issues of concern are:

1) Are there acceptable feedback loops for each job, informing the workers of their performance?

2) Can workers easily identify the targets they need to achieve?

3) Are there clear boundaries between the different jobs so that workers have a sense of identity with their job?

4) Is the cycle time of the tasks long enough to avoid a feeling of routine and repetitive work, yet short enough to allow workers to feel they are making progress?

APPENDIX B
PAVA'S SOCIOTECHNICAL DESIGN METHODOLOGY

1. MAPPING THE TARGET SYSTEM

Although there is no one correct way to analyze non-routine work, a useful approach is to start with the 'tracing of sequences of deliberations. Deliberations are defined as: reflective and communicative behaviours concerning a particular topic. They are patterns of exchange and communication in which people engage with themselves or others to reduce the equivocatity of a problematic issue. Deliberations involve: (a) topics, which are the important problems of critical success factors that face an organization; (b) forums of exchange, where individuals discuss the various topics; and (c) participants-the individuals who take part in such forums. These deliberations are thought to be effective units of analysis since they cut across the organization, and often reveal hidden, non-obvious, or counter intuitive patterns of office work. They are as central to the analysis of non-routine work as linear conversion is to routine work.

2. STRUCTURING FOR MAXIMUM SELF-DESIGN

Since sociotechnical design is only effective when there is a great degree of user self-design, the second stage of Pava's approach involves 'entry, sanction and start up'. 'Entry' refers to the need to gain access to the office and the senior people whose support and approval is necessary. 'Sanction' entails the obtaining of formal approval from the organization's senior management. 'Start up' relates to the establishment of a design group made of key departmental members along with someone who can act in the capacity of a 'facilitater'. This person is often an outside consultant. In addition to the design group, Pava recommends the establishment of a steering group, made up of senior organizational managers to oversee the process, who can help in promoting and gaining approval for the final design proposal.

3. INITIAL SCAN

This can be thought of as the first stage in the actual analysis process, and is similar to that in traditional sociotechnical design. Its objective is for the design group to develop a shared and broad image of the office and the organization as a whole. In undertaking an initial scan, design group members need to:

1) Research a consensus on the global mission of the organization and the goals of their individual department or unit,

2) Develop a statement regarding the organization's philosophy on managing its people,

3) Identify the key internal and external factors which influence the organization and their unit, and

4) Concern themselves with the important historical, social, and physical features of the organization and their unit.

4. TECHNICAL ANALYSIS

This iterative process involves the analysis of the technical subsystem. Here the tools and procedures used to convert inputs into outputs are examines. The focus should be on the management of deliberations instead of the traditional variance matrix used for routine work. The design group should:

1) List the current deliberations, setting priorities on the deliberations and selecting the major ones which require the greatest amount of scrutiny,

2) Note the various forums of exchanges for each major deliberation,

3) Identify the participants and the information they deposit and withdraw for each major deliberation,

4) Identify the inaccuracies, gaps, and other errors which arise in the forums in the discussion of deliberations,

5) Analyze the manifest constituent elements (activities) of office work (e.g. typing, reading, telephoning, travelling, and the like), and

6) Compare and contrast the identified activities and deliberations in a matrix format to allow for a systematic analysis and diagnosis, useful for the next stages.

5. SOCIAL ANALYSIS

This stage involves the analysis of the social subsystem which uses the technical subsystem to convert inputs into outputs. Its main task is to identify divergent values, interdependent parties, role networks, and discretionary coalitions. Once identified, the goal is to create mutual understanding and shared meanings rather than eliminate differences.

This would allow intelligent trade-offs to be made on an ongoing basis. Pava notes four requirements of social analysis:

1) The development of a role network which maps out the parties who participate in the various deliberation,

2) The specification of values which the parties typically adopt,

3) The identification of divergent values between parties which continuously obstruct deliberations, and

4) The recognition of interdependent parties who forge 'discretionary coalitions' for their long-term interest and survival.

Pava contends that it is these discretionary conditions which are the norm in non-routine office work, just as work groups are the social norm for routine work.

6. WORK SYSTEM DESIGN

This stage involves the identification of the best fit between the technical and social subsystems. Finding the best match is not always easy but is critical for the development of successful office systems. The objective, according to Pava, is to create a variety-increasing work system which embraces the notion of redundant functions. Pava outlines a five-step process for matching the technical with the social subsystem:

1) Identify and acknowledge the major deliberations and their associated discretionary coalitions;

2) For each deliberation specify the responsibilities of each discretionary coalition;

3) Develop office worker policies which support effective deliberations between discretionary coalitions;

4) Organizational structural changes which might enhance coordination and responsibility aspects to facilitate major deliberations; and

5) Propose technical improvements, including new procedures and new hardware. To these five steps, Pava adds a sixth.

6) Approval and enactment.

This involves getting the proposed sociotechnical design approved by senior management and then implemented. The design must also be accepted by the rest of the organization.

APPENDIX C

TAPSCOTT'S USER-DRIVEN DESIGN (TUDD) METHODOLOGY

1. OUTLINE OF THE PILOT SYSTEM FEASIBILITY REPORT

a. The pilot system feasibility report

*1. **Summary of opportunities for improvement***

*2. **Summary of pilot alternatives***

*3. **Pilot proposal***

- Configuration
- Functions of the system
- Size of pi' t group

*4. **Functional description of the pilot***

*5. **Proposed hardware and software description***

*6. **Description of approximate costs and anticipated benefits***

*7. **What's next?***

Outline of the specific steps leading to the pilot system specification report:

- Executive briefing and demonstration for some key subgroups within the proposed pilot group.

- Final determination of the pilot group must be made at this time.

- Prepare a draft report covering the system specification. This include: organization design considerations, technical specifications, cost, acquisition plans, and possible patterns for future growth of the system.

2. OUTLINE OF PILOT SYSTEM SPECIFICATION REPORT.

a. System architecture

1. Technical

- System components
- System interfaces
- Overview of hardware/software
- Context-relationship to existing systems

2. Social

- Procedures
- Job design
- Environment

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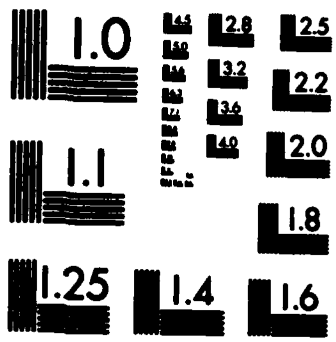

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

b. **Hardware components**

   1. *Configuration/detailed equipment specification*
   2. *System site plan-physical environment for system resources*
   3. *Specification of any hardware construction*

c. **Software**

   1. *Appropriate packages*
   2. *Detailed specification of software to be written*

d. **Organization design**

   1. *Workflow, etc., procedures*
   2. *System responsibilities*
   3. *Job design*
   4. *Physical environment (lighting, workstations, etc.)*

e. **Implementation plan**

   1. *Implementation steps*
   2. *Organization and responsibilities during implementation*
   3. *Management of change (unfreezing, change, consolidation)*

f. **Training**

   1. *Training responsibilities (vendor, client, consultant)*
   2. *Outline of training program*
   3. *Evaluation plan for training program*

g. **Evaluation**

   1. *System monitoring, accounting plans*
   2. *Procedure for refining, extending pilot system*
   3. *Post-test evaluation plan*

APPENDIX D
KEY PRODUCT INTERVIEW GUIDE

Name:____________________
Date:____________________
Product:__________________

TASK STATEMENT

1. Describe your work in accomplishing each task identified on the worksheet.

ACTIVITY QUESTIONS

2. In performing the activity described on the worksheet, what inputs were required from other people/offices?

what	from where	how	how long

3. Which inputs listed in question #2 were critical for your continuing to progress in this activity?

____
____
____
____
____

4. To what degree did you have to manipulate the inputs listed in question #2 to accomplish your activity?

	heavy	moderate	light	none

5. Did you experience any problems of delays in doing your work?

_____ yes _____ no

If yes, what was the cause and the result?

6. If clerical support type functions were performed by you, why?

7. Can you estimate the extent to which you used the office equipment listed below?

hours of use

__________ typewriter

__________ word processor

__________ copier

__________ telephone

__________ facsimile

__________ dictation equipment

__________ other (explain: ____________________________________)

8. Do you maintain any files on the product?

_____ yes _____ no

If yes, for what purpose?

PRODUCT SUMMARY

9. Do you have any suggestions -- organizational, procedural, or technological -- for improvement of product preparation?

_____ yes _____ no

If yes, what and how would it help?

APPENDIX E
OFFICE WORK ANALYSIS

Date: ___________

PROFESSIONAL QUESTIONNAIRE

Name :_____________ Years in present position ______

Title :_____________ Years with organization _______

Office:_____________ Full Time __ Part Time __ (#hrs __)

JOB CHARACTERISTICS

1. Was your workload during the study period:

_____ lighter than normal

_____ normal

_____ heavier than normal

2. Are you now performing any administrative functions that could be delegated to a secretary if the support were available?

_____ typing	_____ posting information
_____ proofreading	_____ preparing forms
_____ photocopying/collating	_____ math calculations
_____ filing	_____ research
_____ telephone coverage	_____ maintaining office
_____ mail sorting/delivery	_____ business errands
_____ composing letters, etc.	_____ using facsimile
_____ taking dictation	_____ other (what? __________)

3. Can you think of any repetitive activities you perform (e.g., recordkeeping, math computations, data analysis, etc.) that could be done more effectively using automated tools?

_____ yes _____ no

If yes, please describe.

INFORMATION/DATA SOURCES

4. What percent of the information/data that you need during an average day is produced by:

_____ % your office

_____ % other offices in your organization

_____ % other government agencies (who? ________________)

_____ % other sources (who? ________________________)

In what format do you usually receive this information?

_____ % computer format

_____ % handwritten

_____ % typed

_____ % other (explain: ________________________)

5. What percent of the information/data that you need during an average week is existing information in your organization that you must collect and reformat for your own use? _____ %

6. To what extent do you have problems receiving the information in question 5 on a timely basis?

_____ very often   _____ sometimes

_____ often   _____ rarely

If problems, please describe:

LEVEL OF SECRETARIAL SUPPORT

7. Who provides most of your secretarial support?

_____ my personal secretary

_____ a secretary I share with others

_____ several secretaries I share with others

_____ no one. I do my own clerical work

(SKIP TO QUESTION 14)

What is the name(s) of your secretary(ies)?

____

8. If you share secretaries, how many other professionals do they support (excluding yourself)? ________________

9. When the secretary is absent, how do you get your work done?

_____ wait for the secretary to return

_____ request work elsewhere as a favor

_____ other (explain: ________________________________)

10. When you are out of the office for a full day or more, how does your secretary(ies) usually spend his or her time?

_____ does work assigned by me

_____ catches up on work that has backlogged

_____ does what needs to be done

_____ works for other people he or she regularly support

_____ assigned temporarily to another work group/department

_____ do not know

11. Does your secretary get assistance when work gets backlogged?

_____ yes _____ no

If yes, how?

12. How satisfied are you with the level of secretarial support provided?

_____ very satisfied _____ somewhat satisfied

_____ satisfied _____ not satisfied

13. What are the five most critical functions the administrative support staff performs for you during the average week?

_____ typing

_____ proofreading

_____ photocopying/collating

_____ filing

_____ telephone coverage

_____ mail sorting/delivery

_____ composing letters, etc.

_____ taking dictation

_____ posting information

_____ preparing forms

_____ math calculations

_____ research

_____ maintaining office

_____ business errands

_____ using facsimile

_____ other (what?________)

14. How would you describe your need for secretarial support?

_____ steady _____ peaks and valleys

If you checked peaks and valleys, when do peaks occur?

_____ particular time(s) of day (why?__________________)

_____ particular day(s) of week (why?__________________)

_____ particular month(s) (why?_______________________)

_____ unpredictable

DICTATION

15. During the average week, do you dictate?

_____ yes _____ no

If yes, you dictate to:

_____ secretary (who:_______________________________)

_____ dictation equipment

16. What documents do you dictate?

_____ 1 page

_____ 2-5 pages

_____ 6-10 pages

_____ over 10 pages

17. If you have access to dictation equipment, but do not use it, why?

18. Have you ever received dictation equipment training?

_____ yes, from vendor _____ no

_____ yes, from other source (who? ____________________)

If yes, was it helpful? _____ yes _____ no

19. Would you like to receive (additional) dictation training?

_____ yes _____ no

20. If you do not currently have access to dictation equipment, would you like to use it?

_____ yes _____ no (what?_________________________)

TYPING REQUIREMENTS

21. What are your typing requirements during the week?

	typical week	heavy week
1-5 pages	_____	_____
6-10 pages	_____	_____

11-19 pages _____ _____

20 or more pages _____ _____

22. What are the average number of typed pages in documents you generate during the week?

_____ 1 _____ 4-9 _____ 20-40

_____ 2-3 _____ 10-19 _____ over 40

23. What percent of the typed work you generate weekly consists of :

_____ % original text

_____ % standardized text

_____ %columns of numbers (statistical)

_____ % pre-printed forms fill-ins

_____ % graphs/illustrations

_____ % other (explain :_____________________________)

24. When you find secretarial errors your typing, what usually happens?

_____ white-out is used

_____ retype entire page

_____ retype corrections on original page

_____ write corrections by hand

_____ other (explain :_____________________________)

25. Is the level of typing support available to you adequate?

	typical week	heavy week
adequate	_____	_____
not adequate	_____	_____
if not adequate, why?	_____	_____

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